COGNITIVE MAPS OF THE WORLD:
A CASE STUDY IN GRADES FOUR THROUGH EIGHT
IN WATAUGA COUNTY, NORTH CAROLINA

A Thesis

by

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ABSTRACT

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A CASE STUDY IN GRADES FOUR THROUGH EIGHT

IN WATAUGA COUNTY, NORTH CAROLINA

(June 1993)

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Cognitive maps are concerned with the contents, locations, and relationships of places in a geographic environment. The importance of studying students' cognitive maps lies in the current concern over geographic education, in the nature of geography, and in the understanding of schema theory.

This study is an attempt to analyze students' cognitive maps of the world as their cognitive maps are represented on sketch maps. The sketch maps were obtained from students between the 4th and 8th grades at two schools in Watuaga County, North Carolina. The author provided a relatively objective system to retrieve, store, and analyze data from the sketch maps.

Three central issues are addressed by examining 249 sketch maps and their accompanying questionnaires, as well as teacher questionnaires. In respect to the first issue, a study by grade level of required items on sketch maps, it was found that the percentage of students who could name

more countries in each continent increased from lower to higher grades, although there was not a progressive change through the grade levels in their knowledge of the continents and oceans. A total of 39 sketch maps were chosen as superior cognitive maps. The numbers of good cognitive maps increased conspicuously in grades seven and eight.

As to the second issue, it was not proved that the social studies curriculum in the North Carolina schools contributed much to the world cognitive maps of the observed students. Further research by different methods will be needed to understand the functions of the new draft of North Carolina's Social Studies Standard Course of Study.

Finally, students' attitudes toward the factors affecting their cognitive maps are analyzed. Students believed that their teachers were the most important factor in developing geographic knowledge, according to their questionnaires. Two characteristics of students drawn from questionnaires were analyzed. These characteristics contain travel experiences in foreign countries and interests in social studies.

Good cognitive maps of the world help students become more geographically cognizant of the world around them. An understanding of students' cognitive maps will enable educators to design more effective school geography programs.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Figure Page

CHAPTER I

INTRODUCTION

Statement of Problem

The need for this study is based on the premise that there are limited studies concerning the ways by which students organize and present their geographic knowledge. The particular concern in this study is the contents and the development of students' cognitive maps of the world.

Three assumptions related to geographic education are basic to this investigation: (1) geographic education plays an important role in determining how students understand the patterns of people and their spatial environments; (2) effective geographic teaching should be concerned with the nature of geographic knowledge and the understanding of cognitive development and background knowledge of students; and (3) students' cognitive maps of the world may serve as a direct and simple method of assessing the quality of geographic education in elementary and middle school classes.

Current discussions, arguments and geographic tests have provided many ideas and much information supporting these assumptions. Natoli and others (1984, II) regarded geography as "... an essential ingredient in the total process of educating informed citizens." Caspar Weinberger (1989) pointed out the need for geographic knowledge in the following quotation:

> The coming Common Market in 1992; the transfer of Hong Kong to the People's Republic of China in 1997; the American trade deficit; and even the enormously heartening daily rejection of communism by the millions of people who have been forced to live under its thumb all of their lives -- all of these and many more events will have a vital impact on America. If we are educated enough to realize it and knowledgeable enough about other countries, we can profit in every sense of the word from these amazing changes...All of this starts with geography (Weinberger 1989, 31).

Numerous studies, however, in the national media have reported that students in the United States are deficient in international understanding. A recent Gallup poll recorded that young adults in the U.S. (age 18 to 24) ranked last in knowledge of geography among nine countries, including Sweden, Germany, Japan, France, Canada, Great Britain, Italy, Mexico and the U.S. One in seven American adults could not locate the U.S. on a world map. Twenty-five percent of the students in Dallas, Texas could not name the country bordering the U.S. on the south (Lineback 1991). Guidelines for Geographic Education: Elementary and Secondary Schools, which was issued in 1984 by the National Council for Geographic Education and the Association of American Geographers, poses the problem as:

> Americans' ignorance of their own country and the world will have dire consequences for our nation's welfare, strength, and global interdependence and for the effects we have on people in other nations. Geographic education is vital to correct this ignorance and can give future generations the knowledge and understanding they need to manage the earth's resources wisely" (Natoli et al. 1984, 1).

It is paradoxical that professional geographers in the

U.S. have made many contributions to the world's finest scholarship and activities in academic geography, while widespread difficiencies in geographic knowledge are present among the general public. One explanation for the situation is that school education has not provided enough attention and spent enough time on geographic education (Heywood 1985). Geography is integrated into today's elementary social studies curriculum, but social studies on the whole is not as important in the curriculum as it should be: two thirds of primary teachers reported that they had had insufficient time to teach social studies (Lengel and Superka 1982).

Another explanation is that our students have difficulties in locating countries' positions and describing their spatial relationships. We might assume that they know the names of countries, such as Mexico or Canada, through some experiences, but they might not know their locations on maps. The test results suggest that our students do not possess substantive geographic knowledge. It is clear, however, that geography is a science that explains the spatial organization of the world and answers locational and spatial questions (Abler et al. 1971). The 1984 Guidelines for Geographic Education provided geographic education for the first time with five central themes to assist in teaching geography. The first and most critical in the discussion is location, or position on the Earth's surface, which was defined as "...a key aspect of understanding interdependence at local, regional, national, and global scales" (Natoli et al. 1984, 3).

The need for research that relates geographic instruction to the nature of geography and children's cognitive development has been expressed frequently. Lucy Sprague Mitchell, who was considered a pioneer of geographic education, suggested that "...the contention that children can be geographers must take into account the nature of both geography and children" (1934, 7). Downs, Liben and Daggs (1988) have pointed out that a successful program of geographical education must be predicated on understanding three main aspects that include the nature of geography content, the nature of child development, and the expectations and knowledge of the teacher. The similar idea was also emphasized in the Guidelines for Geographic Education: Elementary and Secondary Schools (Natoli et al. 1984). The Guidelines reflect an understandable emphasis on disciplinary content, as well as addressing the consideration of child development in the following quotations:

> Geographic instruction at the elementary level should be based not only on key geographic understandings, but also on our knowledge of stages of children's cognitive, psychological, and social development (1984, 10-11).

Unfortunately, there has been little research on the student's understanding of spatial relationships of geographic events and on the ways by which geography has been taught in schools. Saarinen and his colleagues (1993) attempted to assess the geographic knowledge of the students by analyzing their cognitive maps, which is an abstraction representing the world in people's heads (Downs and Stea 1977). Most of their studies are on the global scale. Saarinen pointed out that establishing a world image is very essential in geographic education and is a "...starting point in education for international understanding" (Saarinen 1973, 148). He and others continued providing reasons for their research on cognitive maps (Saarinen et al. 1988, 1993). They believed that the good quality of cognitive maps of the world held by students should reflect their good knowledge of geography, "...derived either from formal learning in schools or informal but systematic learning" (Saarinen et al. 1993, 1). A good cognitive map of the world must be formated with "...knowing the basic configuration of the continents as well as having detailed knowledge of the political subdivisions within each continent" (Saarinen et al. 1993, 1). Mardon (1988) considered that a good knowledge of the world image allowed the individual to have a broad framework from which to develop complex concepts and information.

Thus, investigations should be conducted to learn the development of students' geographic knowledge by grade and how the teaching of geography in school relates to that knowledge, in order to give a ground on which we can teach geography more effectively and enjoyably. The present study attempts to understand students' progression of geographic knowledge by learning how and at what rate they build their cognitive maps of the world.

Objectives

This study is designed to analyze students' cognitive maps of the world as they are represented on sketch maps drawn by students from grade 4 to 8 in two schools in rural Watauga County in North Carolina. The information on sketch maps only included place-names and place-relationships.

The objectives of this study are:

1) to analyze changes in the contents of students' cognitive maps of the world by grade level. The analysis will be based on building a data base by collecting variables from the sketch maps;
2) to evaluate geographic education in schools through students' cognitive maps of the world, to examine the fulfillment of educational objectives in the formation of a world image by students, and to determine whether the formation of students' cognitive maps is related to geographic education. The study examines whether the spatial knowledge represented by the sketch maps of students in Watauga County of North Carolina meets expected geographic outcomes of the

state, and whether the curriculum contributes to the formation of students' cognitive maps of the world; and

3) to determine possible non-classroom factors involved in the contents and development of world images among students, including direct personal experience (travel) and indirect perception (extracurricular education, mass media).

CHAPTER II

BACKGROUND

Geographers have been interested in cognitive maps because of their role and function in geographical knowledge and behavior. Thus, schema theory in psychological and educational fields has provided a broad background for understanding the importance and the meaning of cognitive maps. A literature survey in this study involved schema theory in psychology and cognitive maps in geography. The review is organized into three sections in this chapter. First is the discussion of the general idea of cognitive maps and schema. Second is the antecedent research on cognitive maps of the world. Third is the discussion of geographic education in the school setting in North Carolina.

Cognitive Maps and Schema

Concepts

Cognitive Maps

Image and Environment (Downs and Stea 1973) is usually cited as the first introductory volume outlining the scope and approaches of research on cognitive maps (Gould and White 1986; Lloyd 1982; Saarinen 1988; Tuan 1975; Evans 1980). Downs and Stea define the cognitive mapping as "...a construct which encompasses those cognitive processes which enable people to acquire, code, store, recall, and manipulate information about the nature of their spatial environment" (1973, xiv). Therefore, cognitive maps are people's organized representations of some part of the spatial environment, and they "...are part of our everyday lives" (1973, 9).

Tolman (1948) was the first who used the term, "cognitive maps," in his paper "Cognitive Maps in Rats and Men." He established the idea that rats built cognitive maps which enabled them to direct their movements in their environments. Tolman believed that this required a complicated series of psychological processes over a period of time for rats, but he believed the process was also applicable to humans. Since then, cognitive mapping and cognitive maps have been an interdisciplinary field of research. Scientists have been examining questions relating to the nature of cognitive maps, the process of acquiring and forming such maps, and their role in everyday spatial activity (Golledge and Stimson 1987, 70). The notion of the cognitive map has become a common instrument in the study of man-environment relationships, although the concept of the cognitive map and its proper place within geography has been the subject of some debate (Rushton 1979; Downs 1981; Lloyd 1982).

Schema

Schema is a term in cognitive psychology concerning cognitive structure and representation. Schema theory has its historical precedent in the Gestalt psychology, which was the study of mental organization (Anderson and Pearson 1984). A schema can be defined as an abstract knowledge structure, in the sense that it systematically and meaningfully represents the relationships among its component parts (Bartlett 1932; Anderson and Pearson 1984; Anderson 1983; Gold 1980).

The notion of schemata was first applied to environmental contexts by Lee in 1954, in order to explain the systems in the brain for processing spatial information (Gold 1980). The notion of "spatial schemata" is considered to be the sub-set of schemata with which geographers are concerned (Lee 1976; Gold 1980; Lloyd 1982). A spatial schema may be viewed as "...a framework within which past and present environmental experiences are organized, is accommodating to current sensory information, and is more readily associated with the everyday environment and behavior in that environment" (Lloyd 1982, 535). The content of spatial schemata is divided into two categories: locational knowledge, which supplies the basic structure of geographical space and the orientation and relationship of the elements within it; and attributive knowlege, which supplies assessment of the attributes of places and areas, along with information about how various locations compare with one another (Gold 1980).

Schema and Cognitive Maps

Schema and cognitive maps are closely related, although several distinctions between them -- of degree rather than of type -- are emphasized (Tuan 1975; Gold 1980; Lloyd 1980). Both schemata and cognitive maps are readily associated with our everyday lives and learning process (Downs and Stea 1973; Gold 1980; Llyod 1982), and they are partly concerned with form of knowledge (Downs 1981). In general, geographers have viewed cognitive maps as a special type of schematic structure that helps humans search for and comprehend environmental information critical to location and orientation decisions (Kaplan 1973; Stea 1969; Evans 1980). From this point of view, schema theory in cognitive psychology can be applied to the knowledge of cognitive maps with the understandings of the elements and functions of schema.

Two Elements of Schema Theory

Knowledge representations

Many researchers consider schemata a model of human knowledge (Anderson and Pearson 1984). This consideration has brought up a theoretical issue about the general analysis of knowledge types and their representations.

Although specifying the form and substance of schemata and the process of using them are still a challenge for the theorists, three relatively distinct models in cognitive psychology on how information is cognitively represented have emerged (Anderson 1983; Gagne 1985).

Propositional models of cognitive representation state that information is reserved in lists or associated networks based on abstract representations of meaning (Anderson and Bower 1973; Norman and Rumelhart 1975). A second perspective on cognitive representations of information is the analogical view, which states that internal, imaginal representations maintain some rough, isomorphic correspondence to the external, actual environment (Kosslyn 1983; Shepard and Cooper 1983). The third model of cognitive representations modifies the above views to the position that schema are large and complex units that encode information in the form of propositions, spatial images, and linear orderings (Anderson 1983, 45).

The view adopted in this study is the third model, which can explain the content and location of places in the spatial environment in both propositional and analogical form. Several studies of cognitive maps have utilized the same model (Evans 1980).

The Role of Schema in the Learning and Teaching Process

Most discussions of schema theory have also emphasized the use of schemata to assimilate information. According to Ausubel (1963), in meaningful learning, what one already knows subsumes or anchors what one will come to know. Anderson and Pearson (1984) discussed the theory that a person may modify a schema by being told new information. They argued that individuals will check to make sure new information is consistent with the information already stored and, if it is not, will either reject the new information or modify the old. Lipson (1983) suggested that even young readers will reject text information if it is inconsistent with an existing interpretation that they believe to be correct. Anderson and Pearson (1984) also suggested some implications of this consideration for educational research and practice in comprehension. They concluded that, first, poor students are likely to have gaps in knowledge. Since what students already know is a principal determiner of what they can comprehend, the less they knows, the less they can comprehend. Second, poor students are likely to have an impoverished understanding of the relationships among the facts they do know about a topic. Arbitrary information is a source of confusion, slow learning and processing. Third, poor students are unlikely to make the inferences required to weave the information given in a text into a coherent overall representation.

In summary, schema suggests that instructional designs should provide appropriately organized knowledge because understanding the relationships of elements of information is essential to learning well. Schema theory implies that teachers should teach geography in relation to students' prior knowledge and that they must be aware of what students need to already know in order to learn new materials.

Cognitive Maps in Geography

There are many ways to organize geographical knowledge. "Of the many forms of representation geographers use to understand the world -- numerical, statistical, verbal, and pictorial -- maps often spring to mind as hallmarks of geographical inquiry" (Woodward 1992, 50). The traditionally measured representation of maps reflects one of a number of understandings about reality. However, geographers and psychologists also recognize that "there are intangible or immaterial qualities of reality that should be mapped cognitively or affectively" (Woodward 1992, 52). Geographers are also realizing that "people's perception of places is one of the things we must consider as we try to understand the pattern of man's work on the face of the Earth" (Gould and White 1986, 25). Kenneth E. Boulding pointed out that the study of cognitive representations is "...of peculiar importance, not only because they are of themselves perhaps the most significant part of the total structure, but also because they seem to be accessible in a way that other parts of the image are not" (Boulding 1973, viii). Therefore, the term, cognitive maps, is used to express the idea of the "world in the head" (Downs 1981).

Tuan (1979) suggested five functions of cognitive maps. Among them are two directly relevent to geographic education. First, cognitive maps are a mnemonic device. Knowledge of locations, or even arbitrary assignment to location, assists in the understanding and subsequent recall of people, places, and things. Cognitive maps are also a means to structure and store knowledge. With their devotion to maps and spatial environment, geographers are presumed to have a great tendency to arrange and translate mental knowledge in cognitive maps.

Implications for Geographic Education

There are many different ways to increase geographical understanding through education. Cognitive maps of the world provide the foundation to which to add more information about other nations and peoples. Boardman (1983) indicated that graphicacy, with literacy, numeracy, and articulacy, "...is the most distinctively geographical form of communication. It is essentially the communication of spatial information through maps and other forms of illustration." Sauer claimed that the map "...is sometimes claimed as the language of geography" (1956). David Stea and James M. Blaut (1973) presented their observation on the formation of cognitive maps in children's minds, and their findings suggested that the formation of cognitive maps begins at quite an early age. They provided an argument, which was beyond geography, that learning languages in graphic form might help children who encountered "reading problems" to read easily.

The discussion in this study also suggests that geographers should pay more attention to the cognitive map because of its role in geography and geographic education. First, geographers need some instruments to understand the organization and representation of spatial knowledge in people's heads. Second, cognitive maps store knowledge about the contents, locations, and relationships of places in a geographic environment. Third, knowledge in cognitive maps is stored in both propositional and analogical form. Cognitive maps include abstract labelings of environmental elements and may process information, such as the relative spatial positions and directions of objects in settings by map-like forms. Fourth, cognitive maps can be built up by experience and learning, and the change and growth of cognitive maps are affected by previous knowledge of the geographic environment and maps.

Antecedent Research on the Cognitive Map of the World

Cognitive maps may take on various scales, depending on whether they are covering small areas of geographic spaces or larger regions. According to the concept of cognitive maps, a cognitive map of the world provides evidence of a person's geographical knowledge of the world. Heywood (1985) used the "cognitive map of the world" to refer to the filing structure within the brain that allows them to encode, give meaning, and retrieve information relating to a variety of world matters.

Only a few academic researchers have examined people's cognitive maps of world. Their purposes were to assess developmental stages (Bosowski 1981; Drumheller 1968) and to find "distinctive ethnocentric views of world" (Saarinen 1973, 148) and the values and society of the mapmakers (Saarinen 1988).

Research Techniques

It is impossible to observe cognitive maps without any form of external representation. In The Image of the City, Lynch (1960) first analyzed the utility of sketch maps for obtaining insights into how people mentally structure the city and which elements are perceived as important. Sketch maps are freehand maps which are drawn from memory and help us to organize spatial information (Lynch 1960). It is a popular technique used by academic researchers to investigate the world images of individuals (Bosowski 1981; Saarinen 1973, 1988). It was suggested that the "...value of sketch maps as a measuring device should be increasingly recognized" (Saveland 1978, 277). The sketch-map method provides "...richness of substantive content and a holistic perspective," which is difficult to achieve with other kinds of tests (Saarinen 1988, 114). Students are free to represent whatever they know about spatial concepts and understanding.

There are two major criticisms on the technique found in the literature. One is the difficulty with interpreting the products (Evans, 1980). Another is that sketch maps' data may underrepresent a person's knowledge because of limitations in drawing ability (Blaut and Stea 1974; Golledge 1976). Therefore, several methods to measure students' cognitive maps have been tried (Golledge 1976). One designed by Muller (1985) required students to distinquish the comparative locations of places on their cognitive maps without actually drawing them. There is little doubt, however, that the sketch-map technique can provide richer information than many other methods (Saarinen 1973; Metz 1990).

Some researchers have tried to overcome the disadvantages of sketch maps by carefully analyzing key elements. Wise and Kon (1990, 123) believed that it is possible to define an appropriate and consistent interpretive system to treat the students' sketch maps as a whole. They provided a method for sorting and summarizing the information contained in sketch maps by describing key elements of the sketches in terms of place inclusion, spatial relations, and map conventions. By applying the above system in a classroom, they compared the data from students' pretest and posttest sketch maps and analyzed the class achievement. Their research suggested an easy and appropriate method of interpreting sketch maps by focusing on a single aspect or question at a time.

Although some authors question whether individual differences in drawing ability seriously confound sketch map output, there has been no systematical examination of this topic (Evans 1980). On the other hand, several studies provided suggestive evidence that map experience enhances the accuracy and complexity of hand-drawn sketch maps (Beck and Wood 1976; Evans 1980). Therefore, coupled with Saarinen's (1973) idea of the role of education on the formation of a world image, a conclusion might be drawn that sketch maps from the same classroom might provide a reasonably accurate assessment of curricular impacts on the growth of students' cognitive maps.

Saarinen and Bosowski's Findings

The research by Saarinen (1973) and Bosowski (1980) are the direct antecedent for this study. They used sketch maps in an attempt to answer a number of questions about people's cognitive maps of the world. Saarinen compared sketch maps drawn by students of nearly the same age from four countries, including Finland, the United States, Canada, and Sierra Leone. He collected data from the sketch maps by listing the common items labelled. He expected to find "distinctive ethnocentric views" of the world, and to discuss some "broad cultural biases." He concluded that "there are a number of features common to the world sketch maps of all groups' samples and some unique qualities dependent on the place of origin of the maps." He suggested six possible explanatory factors for his findings, including proximity of places to a student's home, current events, and a variety of cultural factors.

Compared with Saarinen's horizonal cultural research, Bosowski's is a vertical grade level study. She collected sketch maps of the world drawn by kindergarten through senior high school students in 13 states and areas in the United States and two cities in England. Her important finding is that quantity and variety of items labelled by participants increased with age level. This increase took the form of a steplike progression with peaks in grades three, six, and nine. In addition to proving the explanatory factors introduced by Saarinen, she examined several descriptive characteristics of her participants, including favorite school subjects, book types, hobbies, travel experience, and familiarity with maps and map games.

Many of Saarinen's and Bosowski's findings are similar. Their ideas and techniques were used as references for this study. This study hopes to explore more fully the relationships between cognitive maps and geographic education.

Saarinen indicated that cognitive maps of the world, because of the global scale, "...are derived from education rather than from personal experience moving through the environment" (Sarrinen 1988, 114). However, among the hundreds of articles on cognitive maps there are only a few related to geographic education in classroom (Metz 1990; Wise and Kon 1990).

Geography Teaching in School Settings in North Carolina

As in most state public school systems, geography is integrated with social studies curriculum in North Carolina. In 1992, the newly adopted Social Studies: Standard Course of Study in North Carolina reflected the idea that the social studies curriculum should be "geography-based," from grades four to seven. Dr. John Ellington, the director of Social Study in North Carolina, (telephone interview, 8 June

1993) emphasized that one-third of the curricular goals in grades four to seven are geography-based.

The document indicates the purpose and the importance of teaching geography in social studies:

> The study of GEOGRAPHY encompasses the questions, "Where is it," "Why is it there?" and "What of it?". Geography is the stage on which the drama of history unfolds. Geographic understanding helps citizens ask questions about the ways human societies have occupied, used, and been affected by the lands on which they live. Just as knowledge of history can give an understanding of time perspective, knowledge of geography can give an understanding of spatial perspective (1992, 4).

As discussed in the first chapter, successful translating of these ideas into geographic teaching lies in the understanding of the nature of geography and of the background knowledge of students and teachers.

Although we know little of how and when cognitive maps of the students in North Carolina are developed, we hypothesize that the previous social studies curriculum may have not provided basic interactive cognitive maps for school students. This hypothesis is supported by the facts. For example, an investigation by a local television station in Charlotte, North Carolina, documented an appalling absence of fundamental cognitive maps in high school students(WBTV 1992). Simple geographic questions included, "What ocean lies off the east coast of North Carolina?" The fact that many students had not a clue provides an evidence that the cognitive maps of those students were not developed.

This study hopes to provide a better understanding regarding the development of cognitive maps between the fourth and eighth grades under the North Carolina social studies curriculum. The expected outcomes may also have some implications for further social studies curriculum development in North Carolina.

CHAPTER III

GEOGRAPHIC SETTING

Each county of North Carolina is classified as a county school administrative unit, the schools of which (except in some city administrative units), are under the general supervision and control of a county board of education with a county superintendent as the administrative officer (The General Statutes of North Carolina 1992).

Watauga County schools offer a typical cross-section of students in Northwestern North Carolina. The county contains a 1990 population of 36,952 persons, centered on the county seat of Boone. In December, 1992, in order to select a broad representation sample of students to participate in this study of cognitive maps, two schools in the county were chosen, one in the town of Boone and the other in a rural section of the county.

Students from grades 4, 5, 6, 7, and 8 in the two schools were selected for participation in the study. The numbers of students in one school in grades 4, 5, 6, 7 and 8 were 84, 99, 85, 81 and 83, respectively. The numbers of students in another school in grades 4, 5, 6, 7, and 8 were 38, 38, 38, 32, and 38, respectively.

CHAPTER IV

METHODOLOGY

Instruments

The technique used to investigate cognitive maps in this study is a sketch-map exercise. The advantages and disadvantages of the sketch map have been discussed in Chapter II.

Pilot Test

In order to evaluate the design of a sketch-map exercise, including expected detail, contents, and orientation, as well as determining the time necessary for students to draw the sketch maps, graduate students in geography at Appalachian State University were asked to draw their cognitive maps of the world. Their efforts yielded some important information for carrying out the design of the map exercise. The first consideration involved the type of map projection students should be asked to draw in order to convey their world image. Since the concern of this study was in map content dealing with world knowledge rather than students' understanding of mapmaking, it was decided that a formal world map had to be shown to students before they started drawing, in order to standardize the map format.

The second helpful finding from the pilot test was that the items labelled must be standardized in order for the researcher to initiate a comparison of the maps. As a result of this pilot study, the participants were requested to specifically label as many continents, oceans, countries, and islands as possible (Appendix 1).

Instructions

Students at the two Watauga County schools involved in the study were given a blank sheet of 8.5 x 11" paper and instructed to draw a map of the world. Teachers were to read the instructions to the "sketch map exercise" (Appendix 1), then hold up a world map for one minute so that students might see the size and approximate scale of the map. At the end of one minute, teachers were to hide the map and allow students to begin their sketches. After students completed their world maps within the prescribed 30 minutes, they were required to answer the questions on the back of the blank sheet of paper (Appendix 2). Teachers were also asked to fill in a teacher questionnaire (Appendix 3). The tests were administered during September and October of 1992.

Map Organization

A method of statistical analysis was devised before the maps were collected from schools. Statistical Package for the Social Sciences (SPSS) was chosen to process the data.

The sketch maps were organized, cataloged and stored as they were received. On each package of maps accepted from each participating teacher, there were three categories of information: grade level, the name of the school, and the total numbers of maps in the package. Identification numbers were assigned to each map by the author. Since one of the purposes of the study was to analyze the changes of cognitive maps from grade to grade, maps were sorted according to grades. Table 4.1 shows the number of maps in each grade.

Table 4.1 Map Categories

Grade	Map Identification Number	Total maps
4	001 -043	43
5	044 -084	41
6	085 -144	60
7	145 -198	54
8	199 -264	51*

* There was a total of 35 maps drawn by students in the 8th grade in one of the schools. However, it was found after collecting the maps that there were 15 mentally handicapped students within the pool. The 15 maps drawn by these students were non-scorable in this study and were arbitrarily removed from the sample by the author.

Data Retrieval

The data base included two separate parts. Part one was data concerning the contents of the maps which included 38 variables (Tables 4.2 and 4.3). Part two was data from the student questionnaires, which were expected to assist in analyzing factors that may have had an influence in the formation of each sketch map. These questionnaires provided 13 sets of variables used in this study (Table 4.4).

The first aspect, the generalization of contents from the maps, is of importance. It is assumed that the progression of geographical knowledge involving the locations and names of places can be measured through successive grades. Two elements were used to measure this progression: detail and accuracy.

Detail

Detail refers to the items labelled on the maps. During the map exercise, subjects were required to draw and label the continents, oceans, islands and any countries they knew. Therefore, the analysis of detail is based on the numbers of continents, oceans, islands, and countries that each student could draw and identify. The basic idea of examining the numbers of items labelled on the sketch maps was similar to the precedent studies done by Saarinen (1973) and Bowoski (1981), although they analyzed more items on the sketch maps than those continents, oceans, islands,

Table 4.2 Variables for Contents of Maps

Numbers of continents
Numbers of oceans
Numbers of countries inside Africa
Numbers of countries inside Europe
Numbers of countries inside Asia
Numbers of countries inside North America
Numbers of countries inside South America
Numbers of countries inside Oceania
Numbers of countries outside Africa
Numbers of countries outside Europe
Numbers of countries outside Asia
Numbers of countries outside North America
Numbers of countries outside South America
Numbers of countries outside Oceania

Table 4.3 Relationships Between Continents

Relationship between North America and South America
North-South
East-West
relative size
Relationship between South America and Africa
North-South
East-West
relative size
Relationship between Africa and Europe
North-South
East-West
relative size
Relationship between Europe and Asia
North-South
East-West
relative size
Relationship between Oceania and Africa
North-South
East-West
relative size
Relationship between Oceania and Asia
North-South
East-West
relative size

Table 4.4 Variables from Students' Questionnaires

Grade
Gender
School
Travel experience outside the U.S.
Teachers
TV
Travel
Parents
Computer
Books
Curriculum

and countries in this study. Table 4.2 represents the categories of the items in the study collected to analyze the detail of the sketch maps.

Besides two variables concerning the numbers of continents and oceans, the rest of the variables in Table 4.2 involve the numbers of countries in every continent (except Antarctica). Unlike the method of simply enumerating the numbers of continents and oceans named on each map, the numbers of countries on maps were recorded in columns of either "inside the continent" or "outside the continent," according to their right or wrong locations. Right location meant that the countries were drawn within the appropriate continents. Wrong location meant that countries either were drawn on the wrong continents, or were drawn or labelled as the continents. Thus, a foundation was provided to further analyze the accuracy of map contents concerning countries.

Accuracy

Accuracy in this study stands for the degree of students' understandings of spatial relationships between continents, oceans, and countries. The method was designed to be a relatively objective analytical system. The relationships between continents, for example, were measured by recording the comparative positions of the continents. Continents were assigned as six pairs: North America and

South America, South America and Africa, Africa and Europe, Europe and Asia, Oceania and Africa, and Oceania and Asia (Table 4.3). Each continent's position on the north-south direction and the east-west direction was checked against that of its partner. The relative sizes of the two continents were also assessed. Therefore, a continent might be drawn in an incorrect position relative to its comparative continent because it was too far east or west, too far north or south, or because its size was out of proportion. Table 4.3 contains 18 variables regarding the relationships of these pairs of the continents. The criteria to determine the values of the variables are detailed below.

In the measuring system, the value "2" always indicates a correct drawing, with the value "1" means a wrong drawing, and the value "0" represents that there is nothing on the map concerning this variable. For instance, with respect to a correct relationship between North America and South America, the value "2" will be recorded in the column of the variable which represents the north-south direction if the students drew North America north of South America. The value "2" will be entered in the column of the variable which serves the east-west direction, if South America on the sketch map is located relatively eastward compared with North America. The permitted area for the location of the western boundary of South America is shown in Figure 4.1.

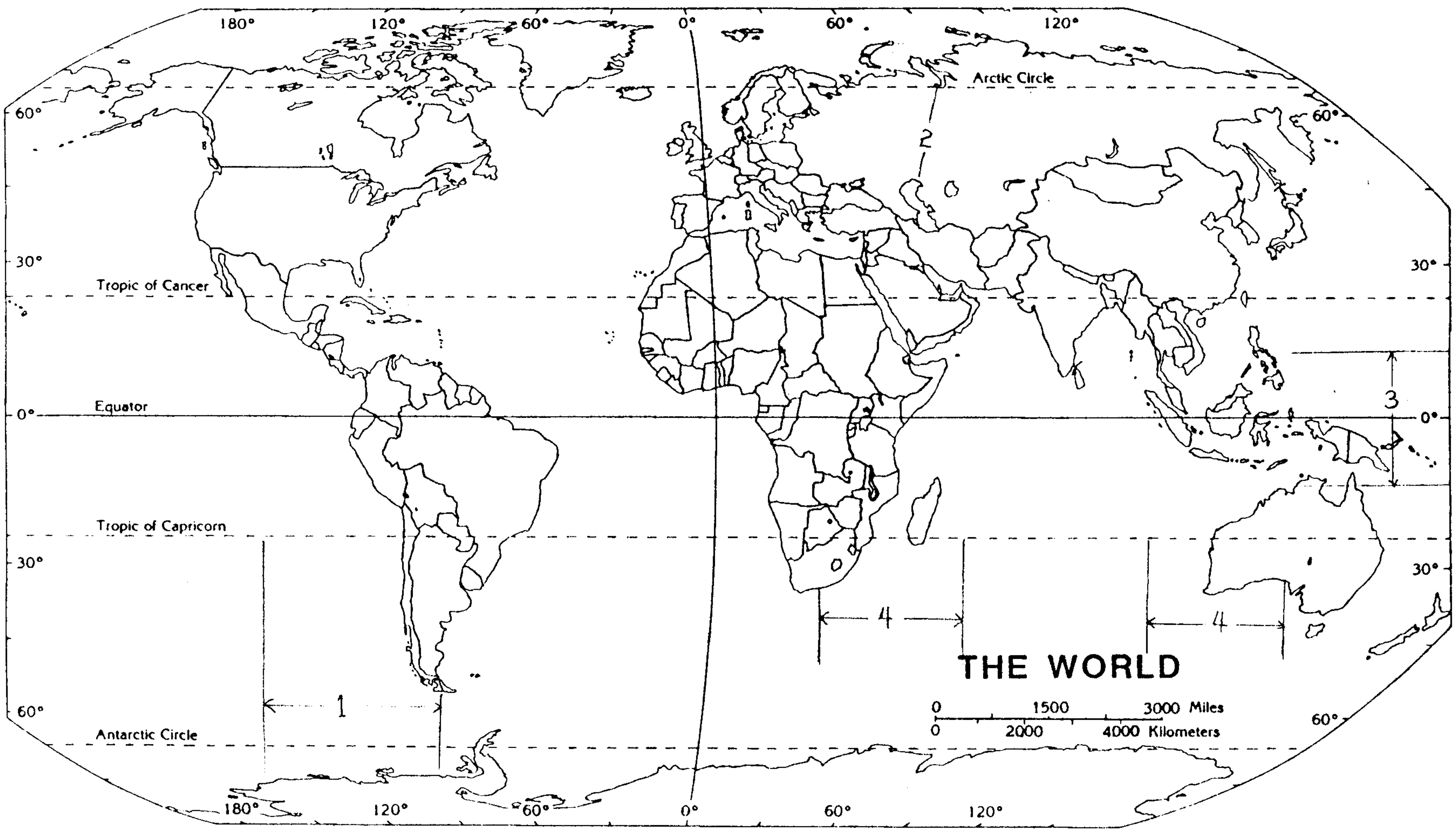

Figure 4.1
Permitted distortion on sketch maps of the world

1. The permitted area of locations of the western boundary of South America
2. The line dividing the former Soviet Union into the European part and the Asian part.
3. The acceptable area of location of the southern boundary of Asia.
4. The acceptable area of eastern and western boundaries of the ocean between Africa and Austrialia.

The value "2" will be written in the column of the variable which represents the relative size, if North America on the sketch map is relatively larger than South America in size. On the other hand, the value "1" will be given to the variable if the drawing on the sketch map did not match the criteria. Finally, the value "0" will be used if neither North America nor South America (or both) were drawn on the sketch map.

In regard to the relationship of South America and Africa, the correct north-south direction means that the northeast boundary of South America is almost at the same latitude as the southern boundary of West Africa. The correct east-west direction means that the distance between the two continents is relatively closer than, or almost equal to, that between North America and Europe. The size will not be considered proportional if South America is larger than Africa.

About one third of the former Soviet Union is considered to be in Europe, when Europe is involved in comparison. Actually most students failed to associate the former Soviet Union with either Europe or Asia. Yet the criteria are still applicable after the author integrated one-third the size of the former Soviet Union into Europe (Figure 4.1). Since the shape of the Mediterranean Sea was hard for students to draw, a space of an appropriate size to indicate the Sea between Africa and Europe was considered acceptable as a correct north-south direction of the two continents. The correct east-west direction means that the two continents are located in the same approximate degrees of longitude. It was considered as a proportional size if continental Europe does not occupy a larger expanse of longitude than Africa does.

To compare Europe and Asia, the correct north-south direction was decided on the basis that Asia shares the same latitude with Europe at the northern boundary and extends farther southward. The acceptable area of location of the southern boundary of Asia is shown in Figure 4.1. As long as Asia was located on the east side of Europe, the east-west direction was determined to be correct. An appropriate size was not accepted unless Asia was about four to five times larger than Europe.

It was determined that subjects had learned Oceania as long as they named and drew Australia, since it is the country in Oceania with the biggest size and most conspicuous shape. The correct north-south direction of Africa and Australia implies that they share almost the same southernmost latitude, or that the southern end of Australia (excepting Tasmania Island) is slightly farther south than the Africa's corresponding extreme. The correct east-west direction was accepted if there was an ocean with appropriate width, labelled the Indian Ocean or not, separating Africa and Australia. The acceptable width of the ocean is shown in Figure 4.1. It was considered correct if the size of Africa is about three and one-half to four times the size of Australia.

The correct north-south direction of Australia and Asia was determined by the location of Australia south of Asia. Regarding the east-west position, Australia should share some degree of longitude with Japan and the eastern coastline of China. It was accepted as correct if on the map Asia was about four times the size of Australia.

Besides the investigation of the continents' directional relationships on the student maps, the understanding of locations of oceans was also measured by recording the accuracy of the labelled oceans, with the variable "the numbers of correct locations of oceans." As discussed in "detail," the accuracy of drawing of countries would be analyzed with data from some variables in Table 4.2.

Table 4.4 contains data for the second aspect of the analysis. These were extracted from the student questionnaires.

CHAPTER V

DATA ANALYSIS

Sketch maps drawn by 249 Watauga County students of the 4th through 8th grades provided considerably more data than the analytical system used in this study required. For the purposes of this study, three central issues will be addressed in the data analysis. The first of these, an examination of the relationship between grade level and sketch map contents, will be developed on the basis of detail and accuracy. The second issue is the relationship between curriculum and the improvement of maps in successive grades. Other factors influencing the formation of world images by students in the sample will be analyzed using questionnaires completed by students and teachers.

Map Contents By Grade

The contents of the 249 sketch maps were examined by analyzing the frequency of occurrence of continents, oceans, and countries. Of the 249 maps used in the study, 10 maps (slightly over 4 percent) included no labels, or consisted of an unidentifiable drawing or writing of some type. These maps were, nevertheless, retained in the data base for analysis.

Detail and Accuracy of Continents

The detail of continents denotes the number of them drawn on the sketch maps. The number of continents is discussed with respect to the total study population and to the maps from each grade level. Before the collection of data from the sketch maps, the "definition" of a continent was decided upon as: a closed area labelled with the correct name of the continent, ignoring misspelling; or a closed area labelled with the names of countries inside, which implies a continent.

Figure 5.1 shows the frequency of occurrence of continents labelled on the maps by the total participants. Only 43.4 percent of the students were able to name the seven continents, while 3.6 percent of them did not name any continents on their maps. A total of 2.4 percent were able to name at least one continent, 2.8 percent named 2 continents, 6.8 percent named 3 continents, 5.2 percent named 4 continents, 12.9 percent named 5 continents, and 22.9 percent named 6 continents.

Figure 5.2 shows the distribution of the students in each grade who could identify all seven continents. Only 7.0 percent of the students in the fourth grade identified all seven continents, while nearly 60 percent of the eighth grades could do so. Significant is the fact that sixth graders outperformed seventh graders, bringing into question the causes of this anomaly.

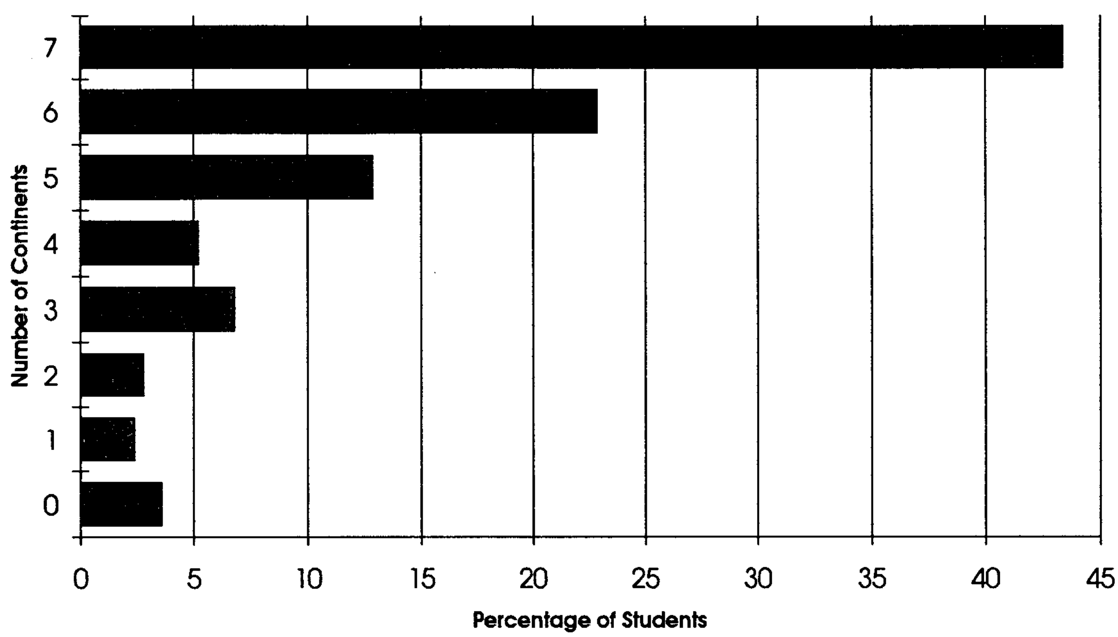

Figure 5.1: Number of continents named by total participants

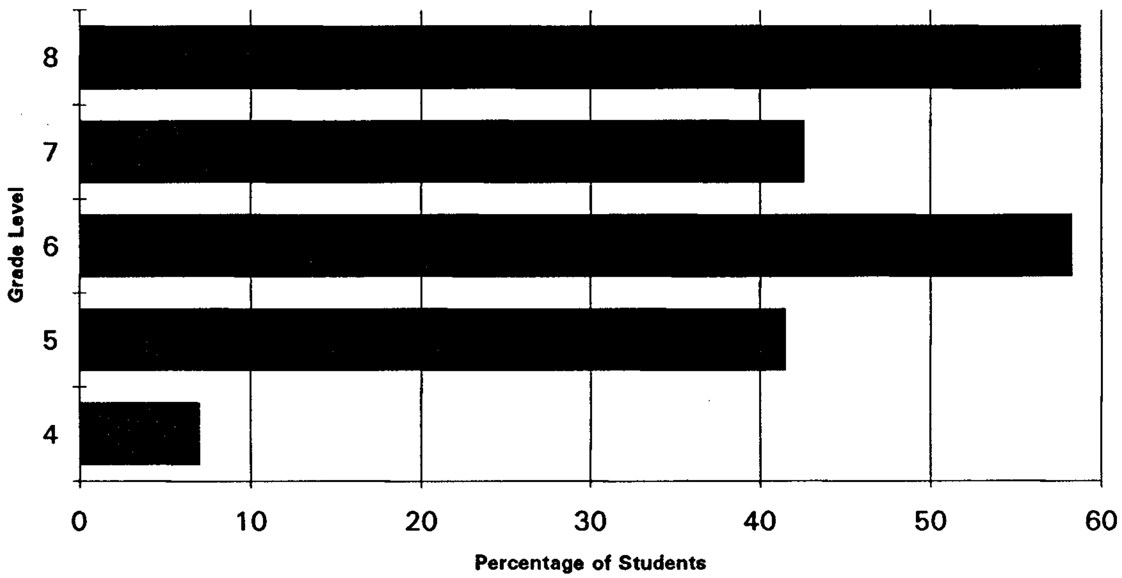

Figure 5.2: Percentage of students by grade who named seven continents

To investigate the accuracy of the continents drawn on the maps by students, the six pairs of continents represented in Table 4.3 were examined. It was explained in the preceding chapter that the correct relationship between two continents requires that all three indices of comparative positions were drawn correctly. Those three indices are the north-south direction, the east-west direction, and the relative size of two continents. The acceptable distortions were also discussed (Figure 4.1).

Figure 5.3 shows that 39.4 percent of the students could not draw any continents' relationships correctly. Only 3.2 percent (8 of 264) could indicate the six relationships correctly. It is clear that there are fewer students who could draw correct relationships of continents than could label the seven continents.

Figure 5.4 indicates the distribution of numbers of students who could draw correct relationships of the six pairs of continents in each grade. There were no significant differences among the grades; between 2 and 5 percent (or only 1 to 3 students) presented the correct relationships of continents in each grade. By checking their maps, it was easily found that they were among the students who could name seven continents.

Detail and Accuracy of Oceans

It was decided while collecting data concerning oceans

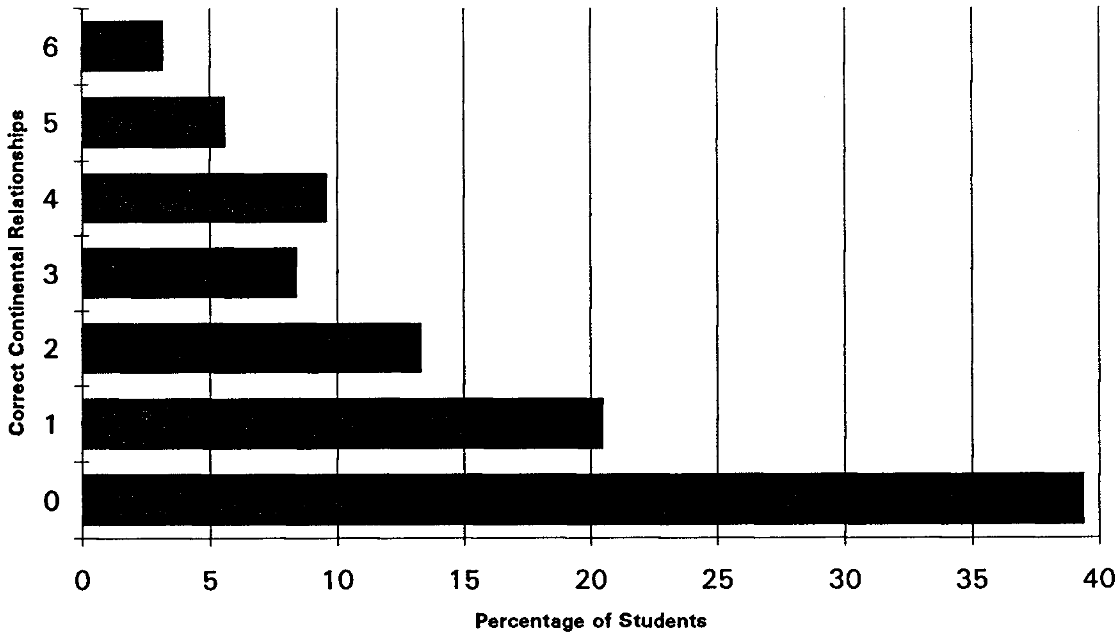

Figure 5.3: Number of correct continental relationships labelled by total participants

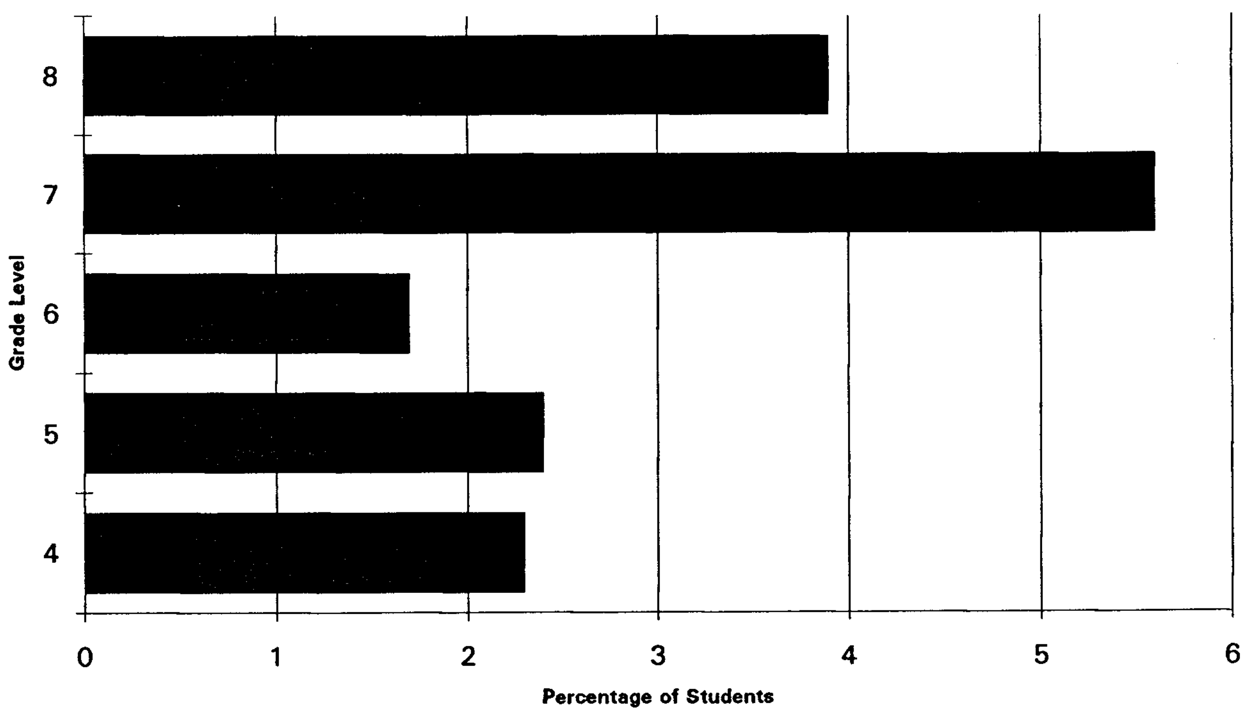

Figure 5.4: Percentage of students by grade who labelled six correct continental relationships

that the word "ocean" need not be written after each ocean's name (with the exception of the "Arctic Ocean"). In other words, the maps were accepted as correctly listing oceans even if the word "ocean" was not included; the exception was the determination that a student might not know the Arctic Ocean if he or she wrote only "Arctic" on a map that correctly identified the others as "Pacific Ocean," "Indian Ocean," and "Atlantic Ocean." (It was decided that some students did not know the Arctic as an ocean since there were maps labelled with "Arctic Continent.")

Figure 5.5 shows the percentage of students who knew the names of the four oceans. A total of 10.4 percent of the students could not name any of the oceans. About 40.2 percent knew four oceans, 24.5 percent of them knew three, and 19.3 percent of them knew two.

Figure 5.6 illustrates the percentage of students, by grade level, who knew all four oceans. As in the case of continents, there were significant differences between grade four and the other grades; only 25.6 percent of the fourth grade students drew four oceans, while 43.9, 41.7, 48.1, and 39.2 percent knew the four oceans in grade five, six, seven, and eight, respectively. But there was not a progressive change throughout the grades in students' knowledge of the oceans.

To analyze the locations of oceans, Figure 5.7 was made to show the percentage of students who drew the oceans in

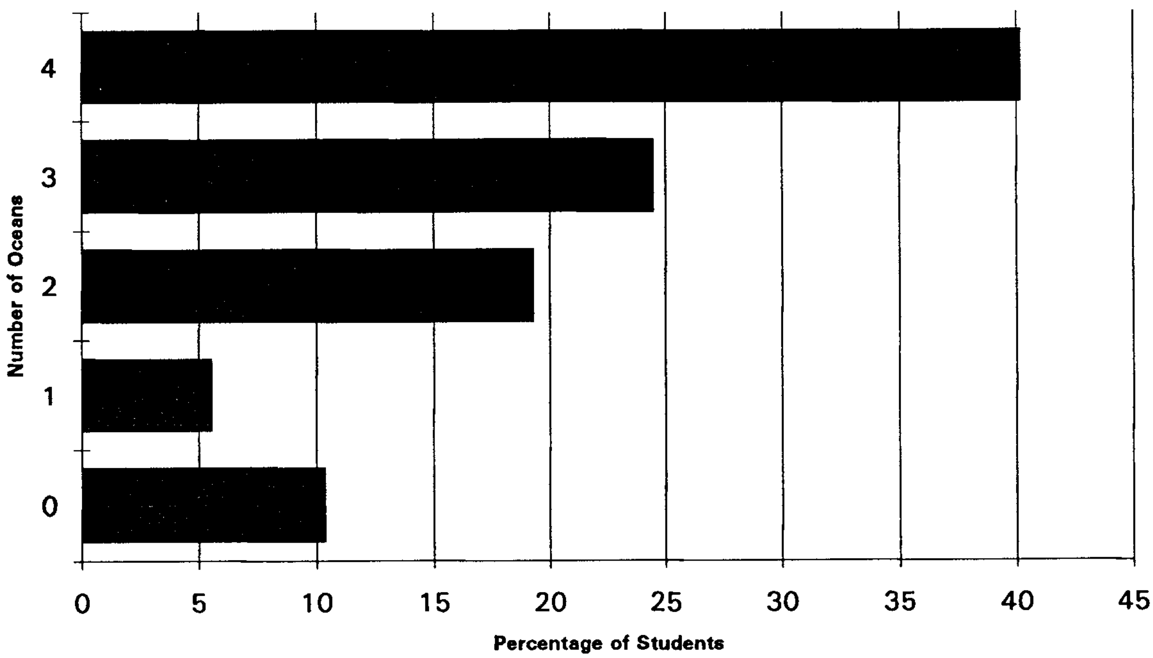

Figure 5.5: Number of oceans named by total participants

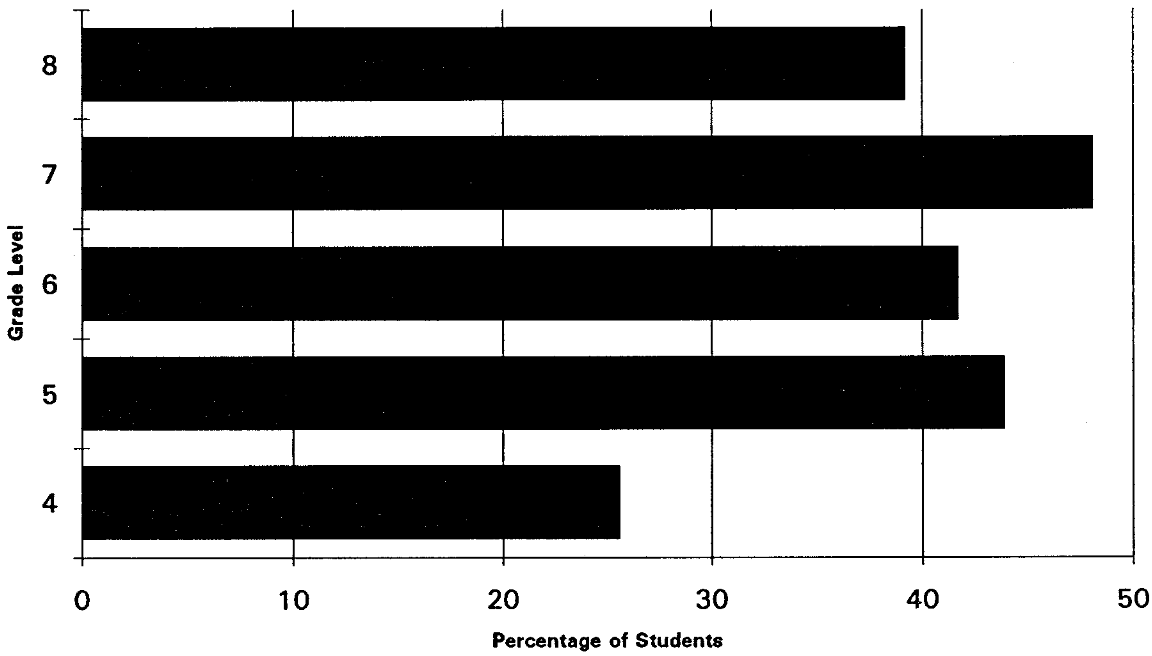

Figure 5.6: Percentage of students by grade who named four oceans

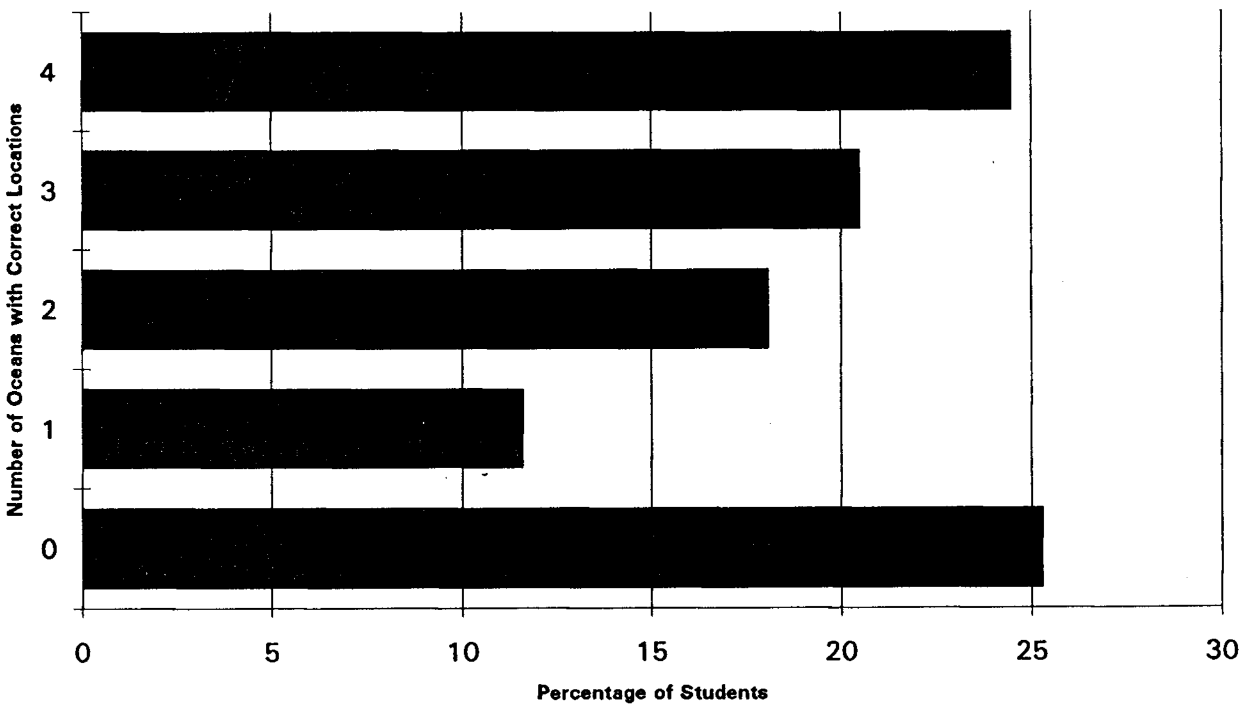

Figure 5.7: Number of oceans with correct locations labelled by total participants

their correct locations. Only 24.5 percent of the students could indicate the correct locations of all oceans; 25.3 percent did not indicate any. A total of 11.6, 18.1, and 20.5 percent could draw correctly one, two, or three oceans, respectively. It is obvious that the students in general demonstrated a better knowledge of oceans than of continents, insofar as both names and locations are concerned.

Figure 5.8 shows the percentage of students by grade level who drew four oceans with correct locations. Only 7 percent of students in fourth grade drew the four oceans correctly, compared to 22, 16.8, 38.9, and 35.3 percent in grade five, six, seven, and eight, respectively.

Detail and Accuracy of Countries

To analyze the detail and accuracy of countries labelled by students on their sketch maps, data concerning the numbers of countries on each continent were computed in three columns. The first column contained the percentage of students who named the countries wherever they were drawn on the maps; the second included the percentage of students who located the countries in the correct continent, and the third was the percentage of students who located the countries outside the correct continent. Table 5.1 lists these percentage distributions for each continent.

One interesting phenomenon indicated by data was that

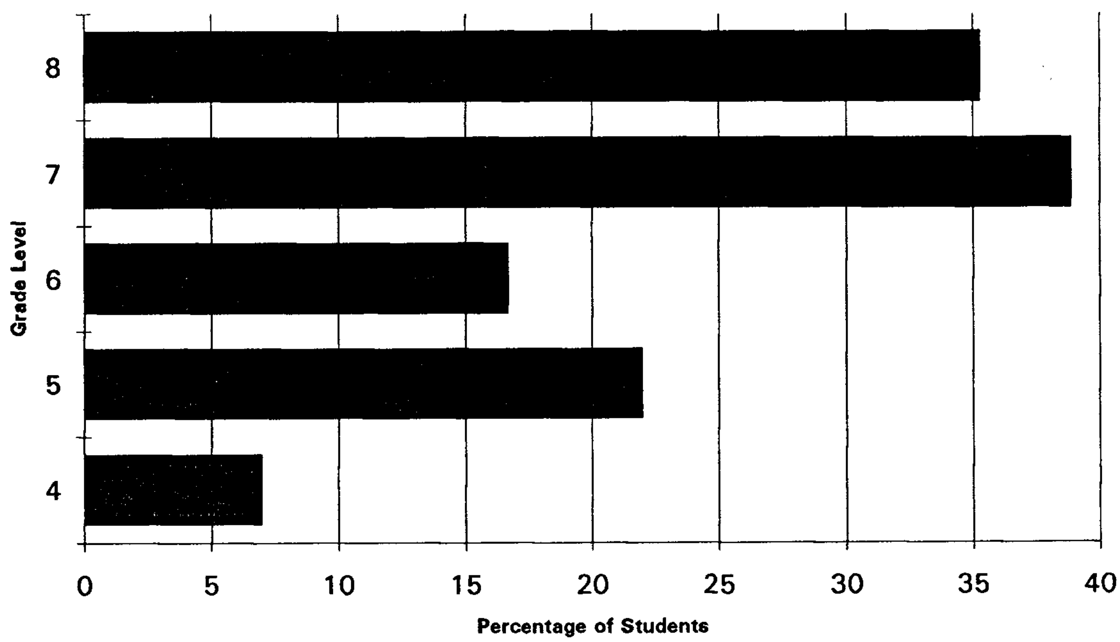

Figure 5.8: Percentage of students by grade who labelled oceans with correct locations

Table 5.1 Percentage Distribution of Students for the Numbers of Countries in Each Continent

	Africa			Europe			Asia			North America			South America			Oceana	
	list	in	out	list	in	out	list	in	out	list	in	out	list	in	out	list	in
1	6.4	5.2	1.2	9.2	6.0	5.2	12.4	6.4	6.0	9.2	13.3	11.6	13.7	13.3	0.4	32.9	32.1
2	4.0	4.0		8.0	6.0	1.6	7.6	4.8	3.2	12.4	8.8	10.8	7.2	6.8	0.4	8.4	8.0
3	3.2	3.2		5.2	4.4	0.4	8.0	8.0	0.4	51.0	39.4	1.6	3.6	3.6		1.6	1.6
4	1.2	1.2		2.0	1.6	0.4	3.2	2.4	0.8				3.2	3.2			
5	1.6	1.6		2.0	2.0		2.8	2.4									
6	0.8	0.8		2.0	2.0		1.6	1.6					1.2	1.2			
7	0.8	0.8		2.0	2.0		1.2	1.2					0.4	0.4			
8				2.4	2.4		1.2	1.2					0.4	0.4			
9	0.4	0.4		2.0	2.0		0.8	0.8					0.4	0.4			
10	0.4	0.4		1.2	1.2												
11	0.4	0.4		1.2	1.2												
12	0.4	0.4					0.8	0.8									
13													0.4	0.4			
14	0.4	0.4		0.4	0.4		0.4	0.4									
15				0.4	0.4		0.4	0.4									
16				0.4	0.4												
17				0.4	0.4												
18							0.4	0.4									
19																	
20																	
21							0.4	0.4									
22	0.4	0.4		0.4	0.4												

students who labelled at least five countries made no mistakes in associating countries and continents. This indicates that students who know more countries have a better understanding of spatial relationships. Moreover, it means that these students have better cognitive maps of the world. There is a small proportion of the students in this category. The distribution of the students in each grade will be described in later analysis.

A somewhat surprising finding is that many students could not locate the three large countries of North America correctly; only 51.0 percent were able to name Canada, Mexico, and the United States. Among the common mistakes was that North America was labelled in the place with the shape of the United States (Figure 5.9). Therefore, North America, instead of the U.S.A, was considered by some to share the status of a country like Canada or Mexico.

To examine the data of countries by grade level, the following tables were designed to represent the percentage of students by grade who labelled the numbers of countries in each continent. Table 5.2a and 5.2b indicate students' knowledge of countries in Africa. Generally speaking, students at every grade level were not very knowledgeable about the African countries. The best result was in the eighth grade, where individual students were able to name 10, 11, 12, 14 -- and in one case, 22 -- countries. Regarding the percentage of the students who labelled one

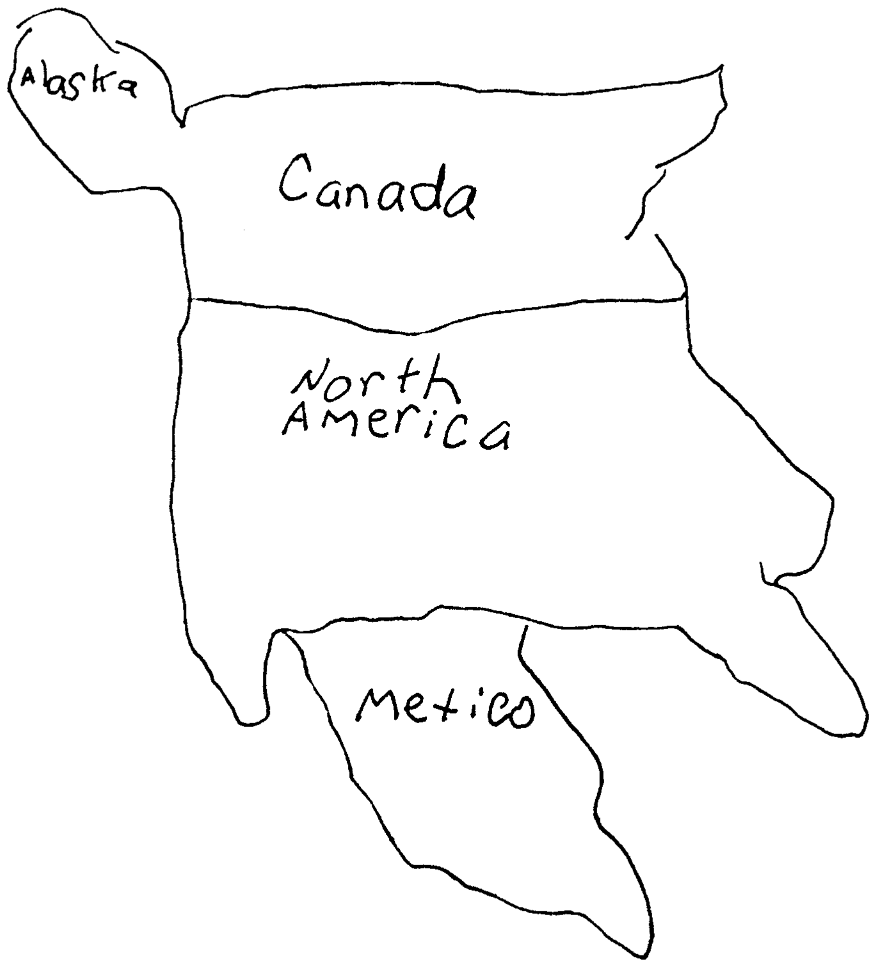

Figure 5.9: An example of North America on sketch maps

Table 5.2a
The Numbers of African Countries Listed by Percentage of Students in Each Grade

Grade	The Numbers of African Countries													
	1	2	3	4	5	6	7	8	9	10	11	12	14	22
4	2.3	2.3												
5	2.4	2.4	2.4											
6	3.3	3.3	1.7											
7	11.1	3.7	5.6	1.9	5.6									
8	11.8	7.8	5.9	3.9	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0

Table 5.2b
The Numbers of African Countries Located Incorrectly
by Percentage of Students in Each Grade

Grade	The Numbers of African Countries		
	1	2	3
4	2.3		
5			
6			
7	3.7		
8			

country, there was a significant difference between grade four-six and seven-eight. Only 2.3 percent of students in grade four and 3.7 percent in grade seven labelled an African country in the wrong continent, but many more were unable to correctly place any African countries.

Table 5.3a and 5.3b indicate students' knowledge of European countries as shown on their sketch maps. Grades seven and eight, with larger numbers and a greater degree of corrections, demonstrated a relatively better knowledge of European countries than did the other grades. Although the sixth graders labelled more European countries than did the fifth grade, 6.7 percent of sixth-grade students did not place one European country correctly (5 percent for two countries and 1.7 percent for four countries).

The students' knowledge of Asian countries by grade is indicated by Table 5.4a and 5.4b. As with European countries, there was a divergance with grade seven and eight in number and accuracy from the other grades. The most consistent mistake displayed in the table is that 20.9 percent of the students in the fourth grade named one Asian country outside the continent.

As discussed in Table 5.2, the students in general demonstrated a lack of knowledge of the locations of North American countries, although it would seem logical for them to know their home continent well. Table 5.5a and 5.5b reveal the percentage of students by grade who named the

Table 5.3a
The Numbers of European Countries Listed by Percentage of Students in Each Grade

Grade	The Numbers of European Countries															
	1	2	3	4	5	6	7	8	9	10	11	14	15	16	17	22
4	14.0	4.7	2.3													
5	2.4	4.9	2.4													
6	16.7	11.7	6.7	6.7	1.7			1.7								
7	9.3	7.4	7.4	1.9	1.9	3.7	5.6	1.9	5.6	5.6		1.9		1.9		
8	2.0	9.8	7.8		5.9	5.9	3.9	5.9			5.9		2.0		2.0	2.0

Table 5.3b
The Numbers of European Countries Located Incorrectly
by Percentage of Students in Each Grade

Grade	The Numbers of European Countries			
	1	2	3	4
4	11.6	2.3		
5				
6	6.7	5.0		1.7
7	5.6			
8	2.0		2.0	

Table 5.4a
The Numbers of Asian Countries Listed by Percentage of Students in Each Grade

Grade	The Numbers of Asian Countries													
	1	2	3	4	5	6	7	8	9	12	14	15	18	22
4	23.3	9.3	2.3											
5	9.8	4.9			2.4	2.4								
6	10.0	6.7	1.7	3.3										
7	11.1	9.3	13.0	5.6	3.7	1.9	3.7	1.9		1.9		1.9		
8	9.8	7.8	21.6	5.9	7.8	3.9	2.0	3.9	3.9	2.0	2.0		2.0	2.0

Table 5.4b
The Numbers of Asian Countries Located Incorrectly
by Percentage of Students in Each Grade

Grade	The Numbers of Asian Countries			
	1	2	3	4
4	20.9	7.0	2.3	
5	2.4	4.9		
6	3.3		1.7	
7	5.6	3.7		
8		2.0	2.0	

Table 5.5a
The Numbers of North American Countries Listed by Percentage of Students in Each Grade

Grade	The Numbers of North American Countries		
	1	2	3
4	14.0	7.0	23.3
5	4.9	7.3	41.5
6	16.7	16.7	51.7
7	9.3	16.7	57.4
8		11.8	74.5

Table 5.5b
The Numbers of North American Countries Located Incorrectly by Percentage of Students in Each Grade

Grade	The Numbers of North American Countries		
	1	2	3
4	14.0	7.0	2.3
5	7.3	17.1	2.4
6	20.0	11.7	1.7
7	11.1	7.4	1.9
8	3.9	11.8	

North American countries, but did not place them correctly. There was a significantly lower percentage of students in grade four who could name three North American countries than in the other grades. Grade eight had the highest percentage of correct answers, yet many of them did not locate the countries in the correct continent: 3.9 percent of eighth graders placed one country incorrectly, and 11.8 percent drew two countries outside the continent.

Although there were not many South American countries misplaced on the sketch maps (Table5.6a), Table 5.6b indicates that students were not familar with many South American countries. Many students in each grade could locate Australia on their sketch maps; however, it was difficult to infer from this whether or not they had a notion of Oceania (Table 5.7a and 5.7b).

After investigating the raw data involving the numbers of countries in each continent drawn on the sketch maps, the author computed a new variable to represent the total numbers of countries drawn correctly on each map. The six variables representing countries placed in correct continents were summed to build the new variable. That variable was examined with respect to its distribution in each grade. Table 5.8 reveals the percentage distribution of the students in each grade who were able to correctly label any country, along with the numbers of countries named and located correctly. The figures ranged widely. About

Table 5.6a
The Numbers of South American Countries Listed by Percentage of Students in Each Grade

Grade	The Numbers of South American Countries												
	1	2	3	4	5	6	7	8	9	10	11	12	13
4	2.3	4.7											
5	7.3			2.4									
6	13.3	13.3	1.7	5.0									
7	22.2	7.4		3.7		3.7	1.9	1.9	1.9				
8	19.6	7.8	15.7	3.9		2.0							2.0

Table 5.6b
The Numbers of South American Countries Located
Incorrectly by Percentage of Students in Each Grade

Grade	The Numbers of South American Countries		
	1	2	3
4			
5			
6	1.7	1.7	
7			
8			

Table 5.7a
The Numbers of Oceanian Countries Listed by Percentage of Students in Each Grade

Grade	The Numbers of Oceanian Countries			
	1	2	3	
4	18.6			
5	24.4			
6	41.7	1.7		
7	31.5	13.0	5.6	
8	43.1	25.5		2.0

Table 5.7b
The Numbers of Oceanian Countries Located Incorrectly by Percentage of Students in Each Grade

Grade	The Numbers of Oceanian Countries		
	1	2	3
4	2.3		
5			
6			
7	1.9		
8		2.0	

Table 5.8
Percentage of the Students by Grade Placing Countries Correctly

Countries	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
0	69.8	51.2	25.0	22.2	9.8
1	4.7	9.8	10.0	9.3	2.0
2	7.0	4.9	10.0	1.9	5.9
3	7.0	17.1	11.7	7.4	5.9
4	4.7	2.4	8.3	11.1	3.9
5	2.3	4.9	8.3	3.7	9.8
6		2.4	8.3	3.7	2.0
7			1.7	3.7	5.9
8	2.3	2.4	5.0	1.9	5.9
9			1.7		2.0
10			1.7	1.9	7.8
11			3.3	3.7	
12		2.4			2.0
13			1.7	1.9	
14				1.9	2.0
15		2.4		1.9	2.0
16					
17	2.3				
18			1.7	3.7	
19			1.7	1.9	3.9
20				1.9	
21				1.9	5.9
22					
23					2.0
24				1.9	2.0
25					3.9
26				1.9	
27					2.0
28				1.9	
29					
30				1.9	
31				1.9	
32				1.9	2.0
33				1.9	
34					
35					
36					2.0
37					
38					
39					2.0
42					2.0
49				1.9	3.9
62					2.0

33.3 percent of the sketch maps included no country labelled correctly, although some continents or oceans might be drawn among them, or there might be countries located in inappropriate continents. The numbers of the maps with no correct country decreased with grade level. More than half of the fourth graders (69.8 percent) and the fifth graders (51.2 percent) could not label any country correctly, as opposed to 25.0 percent, 22.2 percent, and 9.8 percent of students in grades six, seven, and eight, respectively. The correct numbers increased from low grades to high ones. One fourth grader (2.3 percent) and one fifth grader (2.4 percent) could label 17 and 15 countries correctly, respectively. Two of the sixth graders (1.7 percent each) could label 18 and 19 countries correctly. The students in grades seven and eight achieved the greater numbers of correct countries than students in the lower grades. One of the seventh graders (1.9 percent) labelled 49 countries, as did two eight graders (3.9 percent). The greatest numbers of countries labeled correctly was 62 (by an eighth grader).

The Superior Sketch Maps in the Study

A good cognitive map in this study is defined on the basis of the quality of the sketch map, which is an external representation of the cognitive map. The good cognitive maps were identifyed by the following procedure. The first step was to rearrange the variable representing the total numbers of countries drawn correctly on each map, by the percentage of the students. The first quartile of the percentage of the students was accepted with at least 8 countries drawn correctly. The next step was to take the variable representing the correct relationships of six pairs of continents, also by the percentage of the students. The first quartile of this variable was accepted with at least three correct relationships of the continents. The last step was producing a new variable to represent the sketch maps which contained no fewer than three correct relationships of continents and eight countries located in the correct continent. A total of 39 sketch maps were identified as superior maps. Three examples are displayed in Appendix 4. Table 5.9 displays the distribution of these maps by grade. There were none from the fourth grade, three maps from the fifth grade, four from the sixth, fourteen from the seventh, and eighteen from the eighth grade.

Table 5.9

The Numbers of the Good Cognitive Maps by Grade

	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
Maps	0	3	4	14	18

The Relationship Between Curriculum and Improvement of Cognitive Maps

The second concern of this study is to seek close relationships between curriculum and the formation of students' cognitive maps of the world. Social studies courses contain most contents of geographic education in the North Carolina. It was hypothesized that the students should perform better in drawing of regions they had studied than those regions which had not been taught in the curriculum. The goals and objectives of social studies in North Carolina are represented in Table 5.10.

Since the data on sketch maps for this study were collected at the beginning of the school year (September 30 and October 6, 1992) students were considered to have achieved the objectives of social studies which was for the previous grade level. For instance, the fourth grade students were only expected to be able to perform at a third-grade level since they had been fourth graders for only a month. The teachers told the author that they did world map exercises in every grade during the first month, in order to put the new lessons of social studies in a global framework. In some cases, however, the maps were primarily used for context, e.g., to help students understand locations for history lessons, rather than for geography.

Table 5.10

Goals and Objectives of Social Studies in North Carolina

Grade 3	Students should gain understandings about community life in a variety of settings. These settings include Africa, Asia, Europe, and Latin America as well as the United States and North America.
Grade 4	Students should learn about the lands and people in North Carolina
Grade 5	Students should extend their focus to the Western Hemisphere of the United States, Canada, and Latin America
Grade 6	Students should learn about the environments and people of Europe and the Soviet Union, and the primary discipline is geography.
Grade 7	Students should learn about Africa, Asia and Oceania to complete the study of regions of the state, nation, and world. The primary discipline is geography. Maps are used as tools.

Source: <u>Social Studies: Standard Course of Study (1992)</u>. North Carolina Department of Public Instruction.

As discussed earlier, there were no significant differences among the grades. Figure 5.4 indicates the percentage of students by grade who could draw the correct relationships of continents for the six pairs. A series of figures concerning the relationships of each pair of continents are interpreted.

According to the criteria of measuring the continents' relationships, drawing a correct relationship between North America and South America meant that the students learned that South America is located relatively eastward compared with North America; that North America is north of South America on the common world map; and that North America is larger than South America. It seemed that no student knew that South America is located rather eastward since there was no map with a near perfect east-west positioning of North America and South America. The maps accepted as correct for this variable were those in which South America is not located as far eastward as it is on the standard world map, but within the permitted range of error. As shown in Figure 5.10, only 9.3 percent of fourth-grade students met the criteria, but by the eighth grade 68.6 percent of students had a good perception of the comparative location of North America and South America. Although the grade 5 curriculum includes a focus on North America, the improvement shown between fifth and sixth grades was not significantly different from that which was demonstrated in

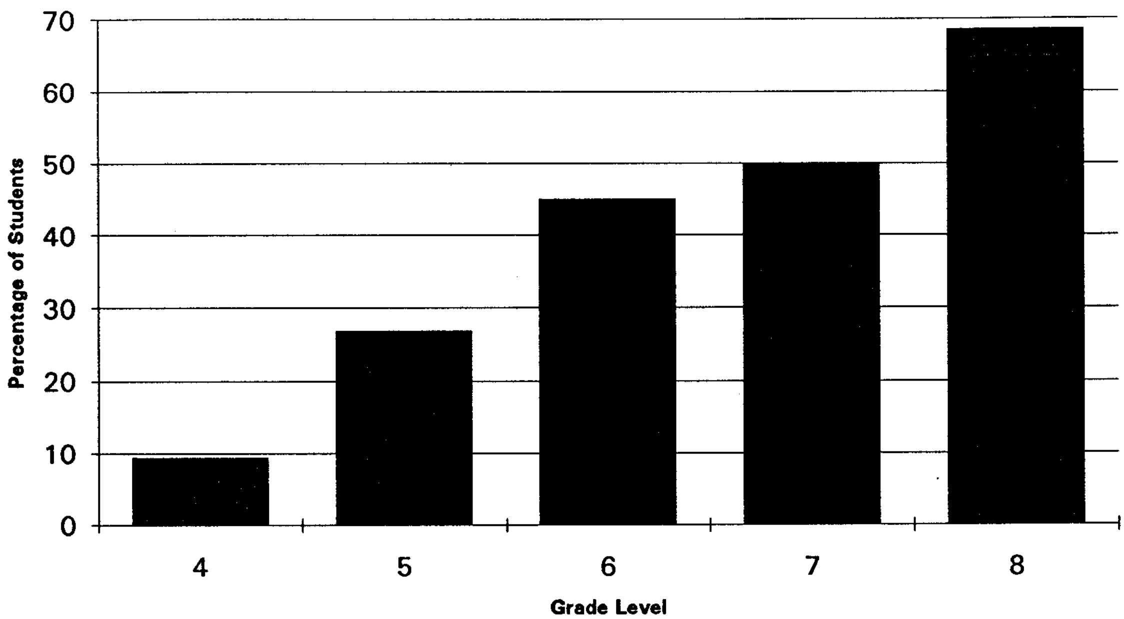

Figure 5.10: Percentage of students by grade who drew correct relationships between North America and South America

other grade levels. It seems apparent that the natural development of children or the world map exercises in the first month of the school year might better explain these findings than do the objectives of the social studies curriculum.

Students who drew the relationship between South America and Africa correctly, according to the measuring standard, could identify that the outlines of South America and Africa are matchable. Figure 5.11 shows that the percentage increased from grade four to five and decreased from grade five to six; then increased sharply from grade six to grade seven before decreasing again from grade seven to eight. Although it was difficult to interpret this result, it was evident that the teaching of social studies did not significantly contribute to a better understanding of the spatial relationship between South America and Africa.

Figure 5.12 indicates the percentage of students correctly drawing the relationship between Africa and Europe increases by grade. The increasing rate of the percentage change of students is not great from grade four to grade five. The rates of change were higher from grade six to seven and from seven to eight than in the other grades. This is to be expected, if teaching served to improve students' comprehension of the relationship between Europe and Africa; these continents are in the curricula for grades

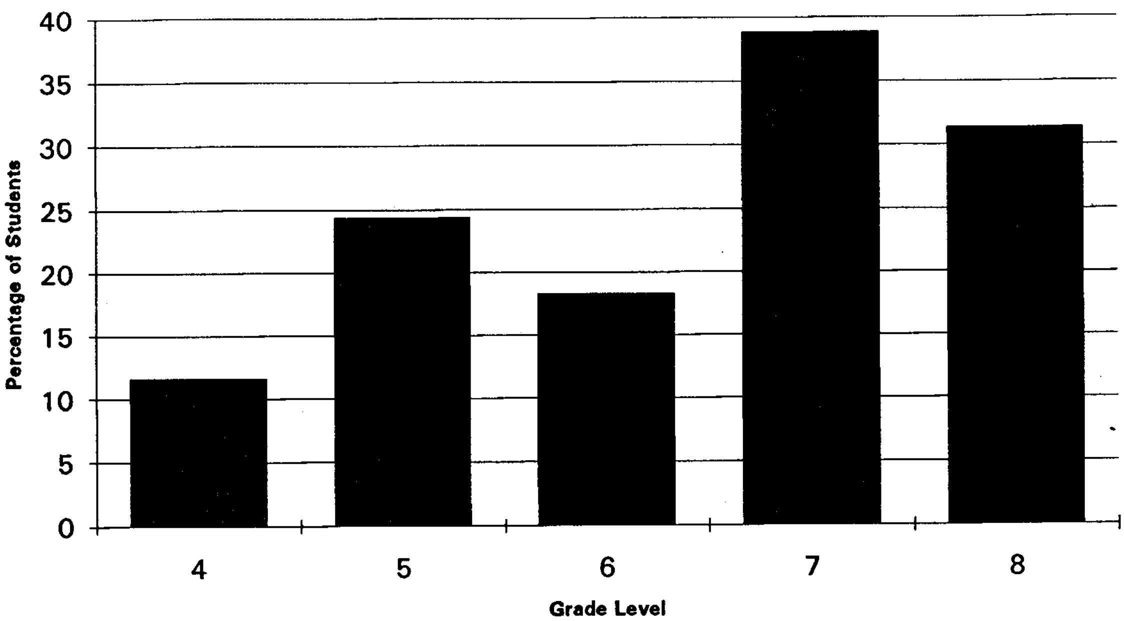

Figure 5.11: Percentage of students by grade who drew correct relationships between South America and Africa

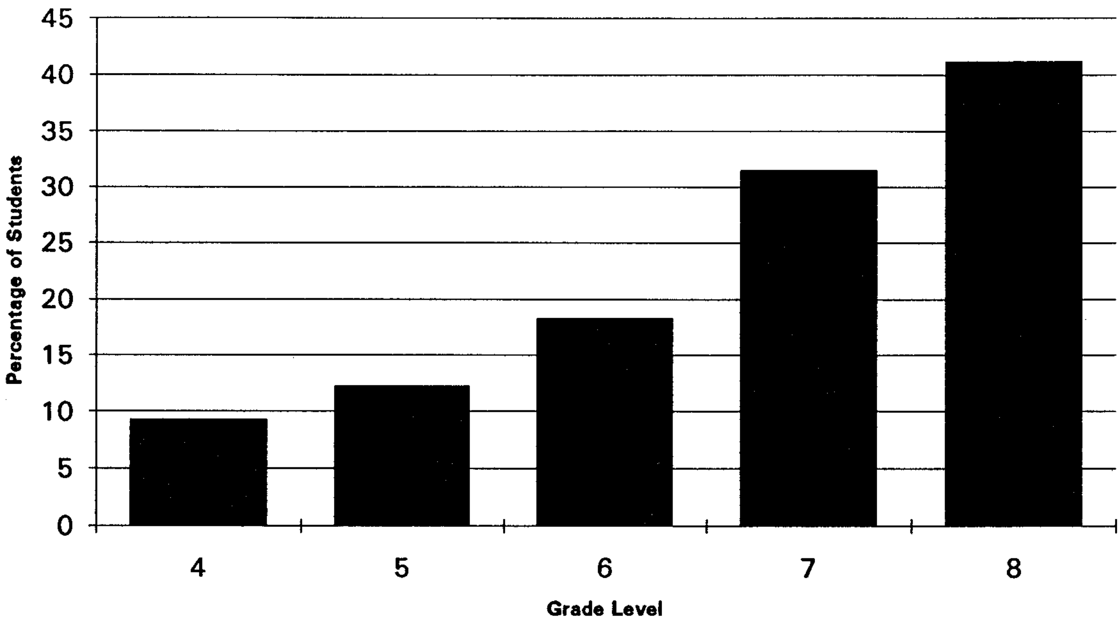

Figure 5.12: Percentage of students by grade who drew correct relationships between Africa and Europe

six and seven, respectively. Figure 5.12 does indicate that teaching may have helped to improve the understanding of the relationship between Africa and Europe.

Figure 5.13 indicates a smoothly increasing rate of changes in the percentage of students from grade five to eight who drew the correct relationship between Europe and Asia. There was a radical difference between grades four and five. These figures offer no clue in the examination of the influence of the social studies curriculum which should foster improvement in grades seven and eight.

Figure 5.14 represents the percentage of students in each grade drawing the relationship between Oceania and Africa correctly. The abrupt increase from the fourth grade to sixth is difficult to explain. Meanwhile, there was no significant change from grade seven to eight, although it would be anticipated as a result of instruction.

The major differences in Figure 5.15 reflect changes from the fourth grade to the fifth and from the seventh to the eighth. The percent change between grade seven and eight might be a consequence of teaching Asia and Oceania in grade seven and using maps as tools; on the other hand, the change could also be explained by other reasons, also applicable to the grade four-five shift. These could include the natural development of mapping ability or the world mapping exercise during the month before data for this study were collected.

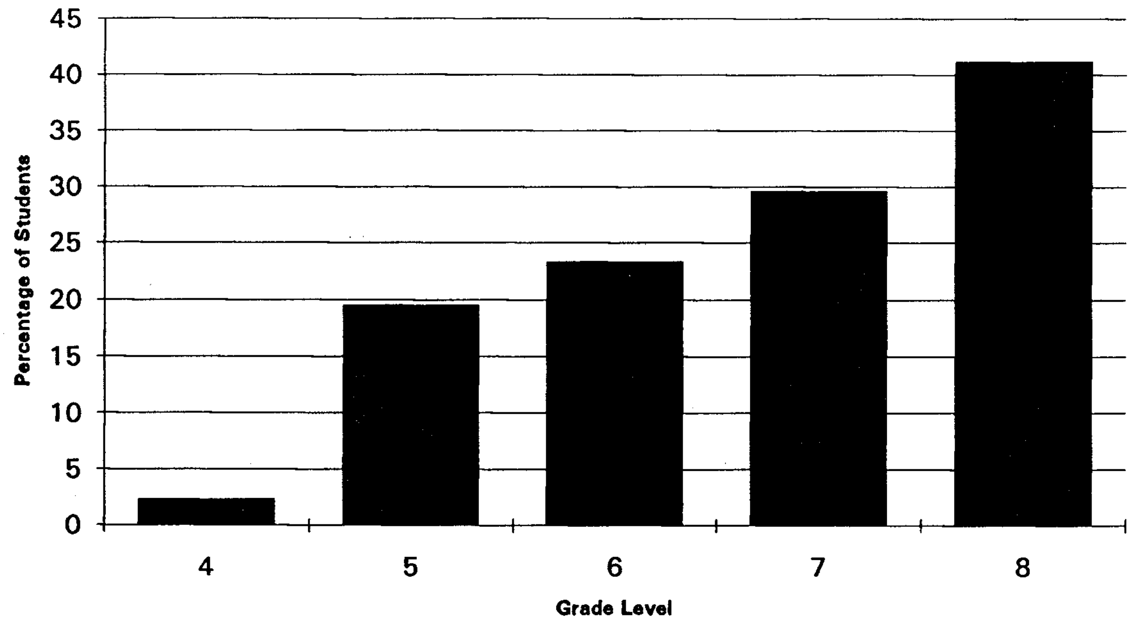

Figure 5.13: Percentage of students by grade who drew correct relationships between Europe and Asia

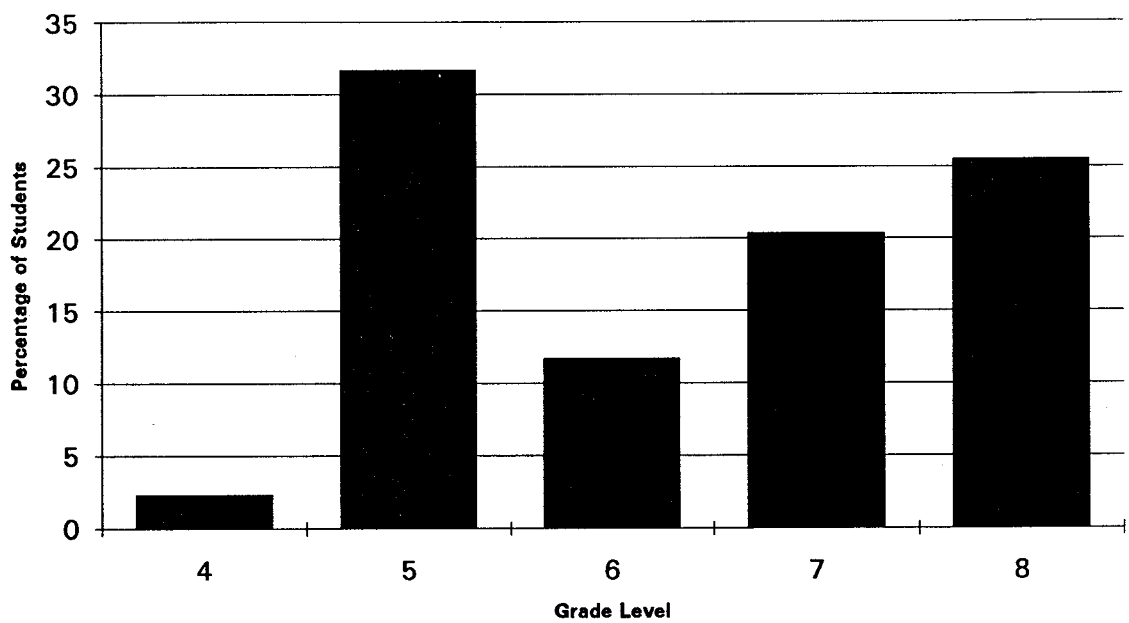

Figure 5.14: Percentage of students by grade who drew correct relationships between Africa and Oceania

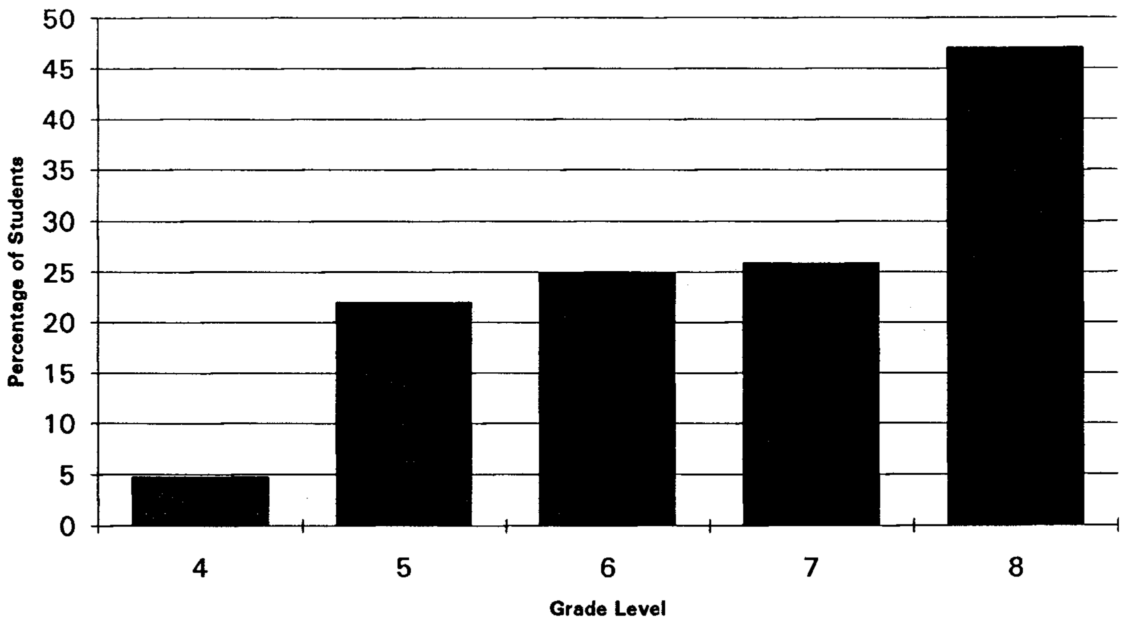

Figure 5.15: Percentage of students by grade who drew the correct relationship between Oceania and Asia

In addition to the improvement of their understandings regarding the relationships between continents, students' knowledge about the countries was also analyzed. Table 5.2 through 5.7 show students' recognitions of the countries in each continent. These tables helped explain the relationships between grade level and sketch map contents, as well as being applicable to the relationship between curriculum and map correctness.

Although in Table 5.2 there are much higher percentages of students in grades seven and eight who knew one African country, it is difficult to prove that the teaching of Africa in grade seven significantly influenced the students' knowledge of Africa. In contrast, the students' knowledge of European countries (Table 5.3) might be affected by geographic teaching in which the goals and objectives of social studies have been emphasized in the classrooms. The environments and people of Europe were taught in grade six, and the continent's geography was established as the primary discipline in this grade. Meanwhile, the percentages of students who knew the correct locations of one, two, or more European countries in grades six, seven, and eight, were higher than those in grades four and five.

It is inappropriate to say that the curriculum did not contribute to the improvements of students' cognitive maps in this study. However, it is evident that the students did not have much better cognitive maps of the specific contents which had been required in the preceding year, according to the above figures and tables.

The teachers' questionnaires provided some answers to this situation. Six teachers believed that they did not spend time on teaching social studies from a geographic perspective. Geography "... is taught on a hit and miss basis within other social studies curriculums" (eighth grade teacher). Most students "...know very little about U.S. geography, let alone world geography" (eighth grade teacher). The teachers did not think that developing students' cognitive maps was one of the purposes of the teaching instructions, and they claimed they needed more help with their own cognitive maps. One teacher cited a lack of knowledge about "...what Yugoslavia looks like now," and that "keeping up with the former Soviet Union --Commonwealth of Independent States -- and Eastern Europe keeps me on my toes" (sixth grade teacher). They hoped that they could have more materials and computer software about geography. They suggested that "a separate course which targets only geography skills should be developed" (eighth grade teacher). They thought that "...more geography should be taught in the lower grades so when history is taught children can visualize where things are going on" (fifth grade teacher).

Factors Affecting the Cognitive Maps of the Students in the Study

The purpose of this section is to examine the subjects' attitudes toward the factors influencing their cognitive maps, and to summarize contributions to the formation and contents of students' cognitive maps of the world. The total participants in the study and the students with good cognitive maps of the world will be examined.

Theoretical Framework

Lloyd (1989) pointed out that people develop their cognitive maps of an area either by direct experience (i.e., navigating through the environment) or by studying maps. Similar points have also been made by psychological researchers and geographers (Thornyke and Hayes-Roth 1982; Downs and Stea 1972). Downs and Stea (1972) discussed that we gain our spatial information and construct our cognitive maps from two different sources: first, sensory; and second, direct and vicarious. In the first, our senses are influential in determining how we understand or interpret our environment. In the second, direct sources include our "face-to-face contact" with another object. To cope, we must select what we intend to or choose to repeat. But, above all, we "learn by doing."

Vicarious sources come, by definition, "second hand."

These sources come to us, "literally and metaphorically," through "someone else's eyes." Such an understanding is true whether it is "...a verbal description, a cartographic street map, a TV film, a written description, a color photograph, or a painting" (Downs and Stea 1973:23). Thus, taken together, all of these factors help explain how we construct our cognitive maps. The questionnaires of the students in this study were determined on the basis of this theoretical frame work and antecedent research work.

The Students' Attitudes toward the Important Factors

The students were asked to answer a few questions, including "Where did you learn most about different places in the world?". There were six choices provided: "your teachers, TV, travel, parents, computer games, and others." Students could make more than one choice.

Table 5.11 represents the factors chosen by the students. Of 242 students who responded to the question, 78.9 percent claimed that they learned about different places from their teachers. Watching TV had played a secondary role in students' place knowledge, according to their responses. About 40.1 percent of total students revealed that TV was one of the sources from which their basic geographical knowledge came. Almost as many (39.3 percent) indicated their parents as a source of place

Table 5.11

Students' Attitudes toward Influencing Factors *

Choice	Percentage of students
Teachers	78.9
Television	40.1
Travel in the country	19.8
Parents	39.3
Computer	15.3

* Of the total 249 participants of the study, 242 students answered the questions

knowledge. It was unexpected that only 19.8 percent of the students indicated travel as the primary method of expanding their geographic knowledge, probably because most of students in the study had little travel experience. Students were not required to mention the specific games and were just asked the general influence of their computer game experiences. Only 15.3 percent of students chose computer games as a significant factor in their place knowledge.

When the responses to this question are examined by grade level (Table 5.12), it is apparent that there was no major change from grade to grade concerning teachers as a main factor contributing to students' geographic knowledge. The same is true for TV, travel, and computer games. The relatively major difference is that 51.2 percent of fourth graders indicated their parents were an important influence, while only 39.3 percent of total students chose this factor.

The Attitudes toward the Main Factors from Students with Superior Sketch Maps

One of the research questions in this issue is to investigate what the students who drew good sketch maps considered the main influences on their cognitive maps of the world to be. As discussed earlier, the good sketch maps in this study contained no fewer than three correct relationships of continents and eight countries located within the correct continents. The responses of students

Table 5.12

Responses to the Choices by Grade

	GRADE					
	4	5	6	7	8	TOTAL
Teacher	72.1	87.2	75.4	75.0	86.3	78.9
TV	37.2	30.8	33.3	42.3	54.9	40.1
Travel	20.9	17.9	24.6	21.2	13.7	19.8
Parents	51.2	46.2	31.6	36.5	35.3	39.3
Computer	11.6	20.5	10.5	21.2	13.7	15.3

who drew good sketch maps were compared with the other students, in an attempt to answer this research question. Table 5.13 shows the attitudes toward the major factor influencing geographic knowledge of the two groups of students--those drawing good versus poor sketch maps.

With similar percentages for both student groups, there seemed to be little relationship between the attitudes of observed students to the five choices in table 5.13 and the qualities of their sketch maps. The chi-square-based measurements were used to test if the results are due to chance. The Pearson chi-square statistic provided a test of the null hypothesis that the percentage of students in the population indicating "teacher" as the main influence on their cognitive maps is the same for those with good sketch maps and those with poor sketch maps. The significance level of 0.389 in Table 5.14 indicates that the null hypothesis must be accepted. Rejection would be done with a 38.9 percent probability of rejecting a null hypothesis that was true. In other words, Table 5.14 suggests that the quality of student sketch maps was unrelated to students' perceptions of teachers as an important factor. Similar tests were applied for those students who listed TV, travel, parents, and computers as their most important sources. Test statistics were similar for these choices (Table 5.14).

Table 5.13

The Percentage Distribution of Students Naming the Influencing Factors.

	Teachers	TV	Travel	Parents	Computer
Good Maps	75.7	43.6	20.0	38.5	17.9
Poor Maps	82.1	38.1	15.4	38.1	14.3

Table 5.14

Significance Level of Pearson Chi-Square Measurement

Choices	Significance Level
Teachers	.38990
TV	.51815
Travel	.50221
Parents	.96550
Computer	.55477

Other Factors Affecting the Sketch Maps

The responses to other questions in the questionnaires of the students were also compiled and analyzed. They included an interest in social studies and student travel experiences in foreign countries.

The students were asked to list two of their favorite subjects in their questionnaires. Among 15 subjects mentioned in the responses, social studies was the first or second favorite subject for only 15.8 percent of the students who drew good sketch maps. Similarly, 15.6 percent of the students who did not draw good sketch maps considered social studies to be their first or second favorite subject.

One difference between the two groups was travel experience. Table 5.15 shows the degree of travel experiences of the two groups. The Mann-Whitney U test was used to test the hypothesis that travel experience was the same for students with good sketch maps as for those with poor sketch maps. The hypothesis was rejected because the significance level was 0.0079; there would be a 0.8 percent probability of having rejected a null hypothesis that was true if it was rejected. Therefore, students' travel experiences in foreign countries are related to the good sketch maps, in general.

Table 5.15

Percentage of Students Who Traveled Internationally

Numbers of countries traveled	good map	not good
0	68.2	85.7
1	23.1	9.0
2	5.1	1.4
3		
4		.5
5	1.0	
6		.5
7		.5
8		
9	2.6	.5

CHAPTER VI

CONCLUSIONS

The importance of studying students' cognitive maps lies in the current concern over geographic education, in the nature of geography, and in the understanding of schema theory. Geographic tests have shown the difficulties students have in locating countries and describing their spatial relationships. The nature of geography requires that the focus of geographic education be on the spatial knowledge and spatial representations of the information. Cognitive maps are concerned with the knowledge of the contents, locations, and relationships of places in a geographic environment. Schema theory suggests the understanding of the form of cognitive maps, and also implies the necessity of learning the existing cognitive maps of the students before providing further instructions. This research particularly focuses on cognitive maps of the world.

Different methods have been applied to understand and evaluate the cognitive maps. Drawing a sketch map is one of the common and effective methods and was used in this study. The author provided a relatively objective system to retrieve, store, and analyze data from the sketch maps.

Three issues were discussed in relation to the research objectives. The first was a study by grade level of required items (including continents, oceans, and countries) on sketch maps, in respect to the detail and accuracy of each item.

Regarding the numbers of continents, there was a gap between students in fourth grade and other grades. There were no significant differences in the numbers of students in each grade who could draw the correct relationships of continents. There were fewer students who could draw the correct relationships of continents than could label the names of the seven continents, both in respect to the total population and to the grade level.

There were no major changes in the students' knowledge of the names of the oceans by grade level, while the knowledge deficiency of oceans' locations was found in grade four, compared with other grades. Generally speaking, the students demonstrated a better knowledge of the names and the locations of oceans than of continents. It is hypothesized that this result is due to the different amount of information: i.e., it is more difficult to learn seven continents than four oceans.

The numbers and locations of countries both in total and in each continent were analyzed by grade level. The students who knew more countries had a better understanding of spatial relationships. The United States was mislabelled as North America by many students. Although there was not a progressive change through the grade levels in students' knowledge of the continents and oceans, the percentage of students who could name more countries in each continent increased from lower to higher grades. Most of the seventh and eighth graders correctly labelled more countries in each continent than did younger students.

The superior sketch maps were determined by selecting those that contained no fewer than three correct relationships of continents and eight countries located in the correct continents. A total of 39 sketch maps are qualified according to this definition. Assuming the authors of these sketch maps had the best cognitive maps, the numbers of good cognitive maps increased conspicuously in grades seven and eight.

The second analysis focused on the relationship between the state's curriculum and the quality of maps, especially in terms of continents and countries, in successive grades. Generally speaking, it was not proved that the social studies curriculum in North Carolina schools had contributed much to the world cognitive maps of the observed students in their school years. To understand the functions of the new draft of North Carolina's Social Studies Standard Course of Study, research demands some comparative analysis, such as pre-tests and post-tests, tracking the same group of students from grade to grade, and so forth.

The third issue concerns the observed students' attitudes toward the factors affecting their cognitive maps.

Students believed that their teachers were the most important factor in developing geographic knowledge. Among the attitudes toward five choices concerning the influences, there were no major differences by grade level, except for fourth graders, who were more likely to credit their parents.

While students' attitudes were examined in two groups -- students with good cognitive maps and those with poor cognitive maps -- there were few differences as to the perceived influencing factors. Although it was assumed that students who drew better sketch maps of the world were more likely to be interested in social studies, there appeared to be no difference in their attitude toward the curriculum from others. One distinction indicated by the study was that students who claimed to have traveled in foreign countries attained better quality in their sketch maps.

Meaningful geography teaching should enhance students' understandings regarding spatial concepts and spatial relationships. Good cognitive maps of the world help students become more geographically cognizant of the world around them. An understanding of students' cognitive maps will enable educators to design more effective school geography programs.

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APPENDIX 1

Sketch Map Exercise

SKETCH MAP EXERCISE

INSTRUCTIONS:

1) Make sure that there are no maps of any kind on the walls of the classroom or otherwise visible to your students.

2) Each student will need a pencil with an eraser before the exercise begins.

3) Hand out and ask the students to fill out the simple student questionnaire. When they are finished, do not take up the questionnaire. (They will use the back to draw their sketch map.)

4) Hold up the sample sketch map that was included in your package for about one minute, walking around the room so that every student is able to see it. The idea is to allow them to see the general scale of the map that they are to draw. Tell the class that each student will be asked to draw their map of the world that should look like the one you are holding up.

5) Tell the students that they will have 30 minutes to work on their sketch map of the world. Have them draw their sketch map on the back of the Student Questionnaire. They should draw the continents and any countries, islands, and oceans that they know. Ask them to label as many features as possible.

6) At the end of the exercise, take up the sketch maps immediately. Fill out the teacher questionnaire and place all materials in the envelope. Turn the envelope into the Principal's Office.

Please thank your class for us. You might also want to talk with your students about how important our mental maps are in everyday life. This will help explain to your students how we use our mental maps to answer questions and solve problems.

APPENDIX 2

Student Questionnaire

STUDENT QUESTIONNAIRE

GRADE ________

BOY____ GIRL____

NAME OF SCHOOL ______________________________

NAME OF SCHOOL ______________________________

WHO WAS YOUR TEACHER LAST YEAR ? ________________________

LIST ANY FOREIGN COUNTRIES YOU HAVE VISITED AND YOUR AGE AT THE TIME OF THE VISIT:

____

____

WHERE DID YOU LEARN MOST ABOUT DIFFERENT PLACES IN THE WORLD?

YOUR TEACHER ____ TV ____ TRAVEL ____

PARENTS ____ COMPUTER GAMES ____

OTHERS (LIST) ____________________

WHAT TYPES OF BOOKS DO YOU READ MOST: ____________________

WHAT ARE YOUR FAVORITE SUBJECTS ? ________________________

APPENDIX 3

Teacher Questionnaire

TEACHER QUESTIONNAIRE

SCHOOL: ____________

GRADE: ____________

CLASS SIZE: ____________

TEXTBOOKS RELATED TO WORLD GEOGRAPHY USED IN CLASS:

____

____

____

REFERENCE BOOKS RELATED TO WORLD GEOGRAPHY USED IN CLASS:

____

____

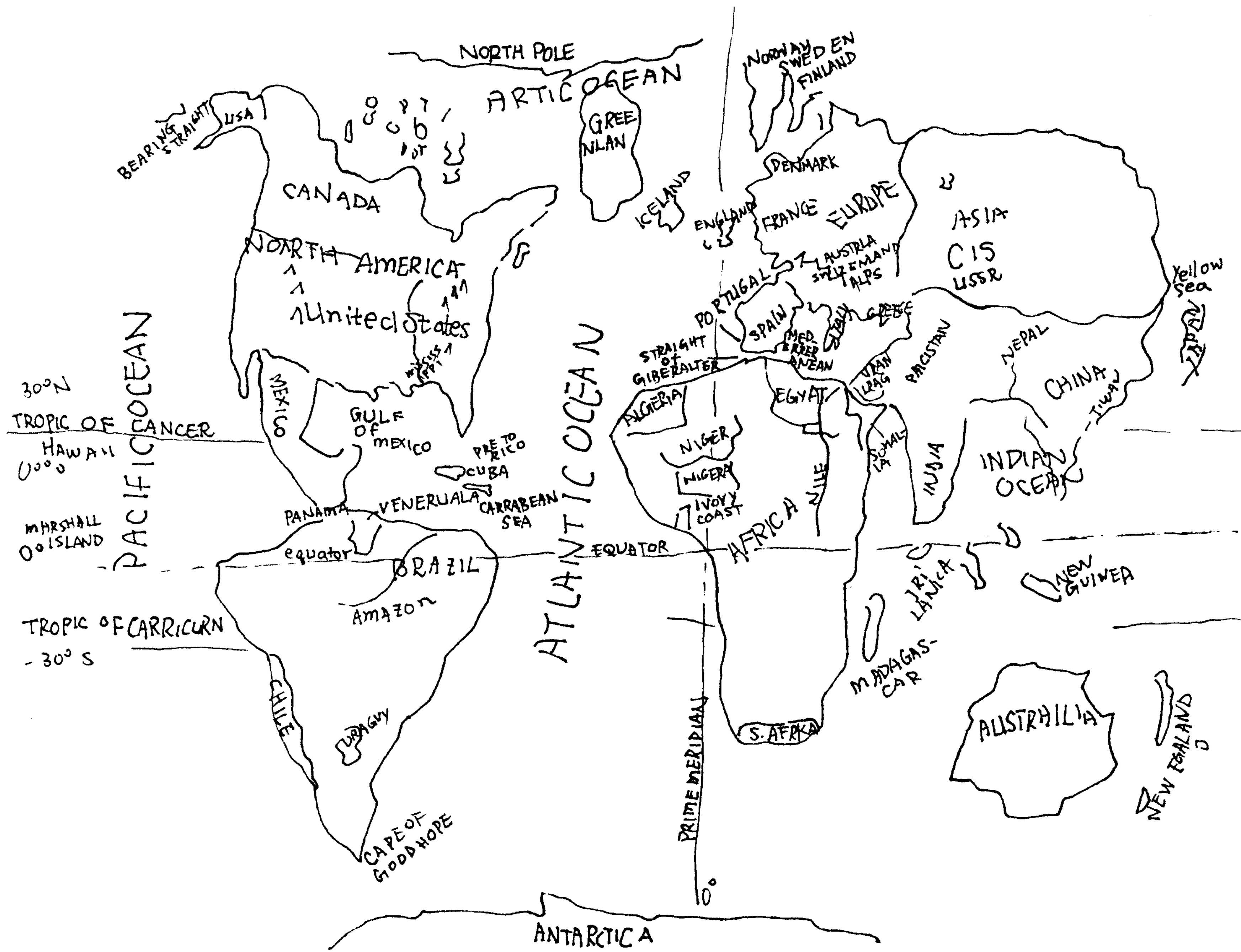
____

Are there other aids in your classroom that help students learn world geography? (please be specific.)

What, in your opinion, is your greatest need in helping your students develop their mental maps of the world?

APPENDIX 4

Examples of Superior Sketch Maps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AUSTRLA SWITZERLAND ALPS
PORTUGAL
SPAIN
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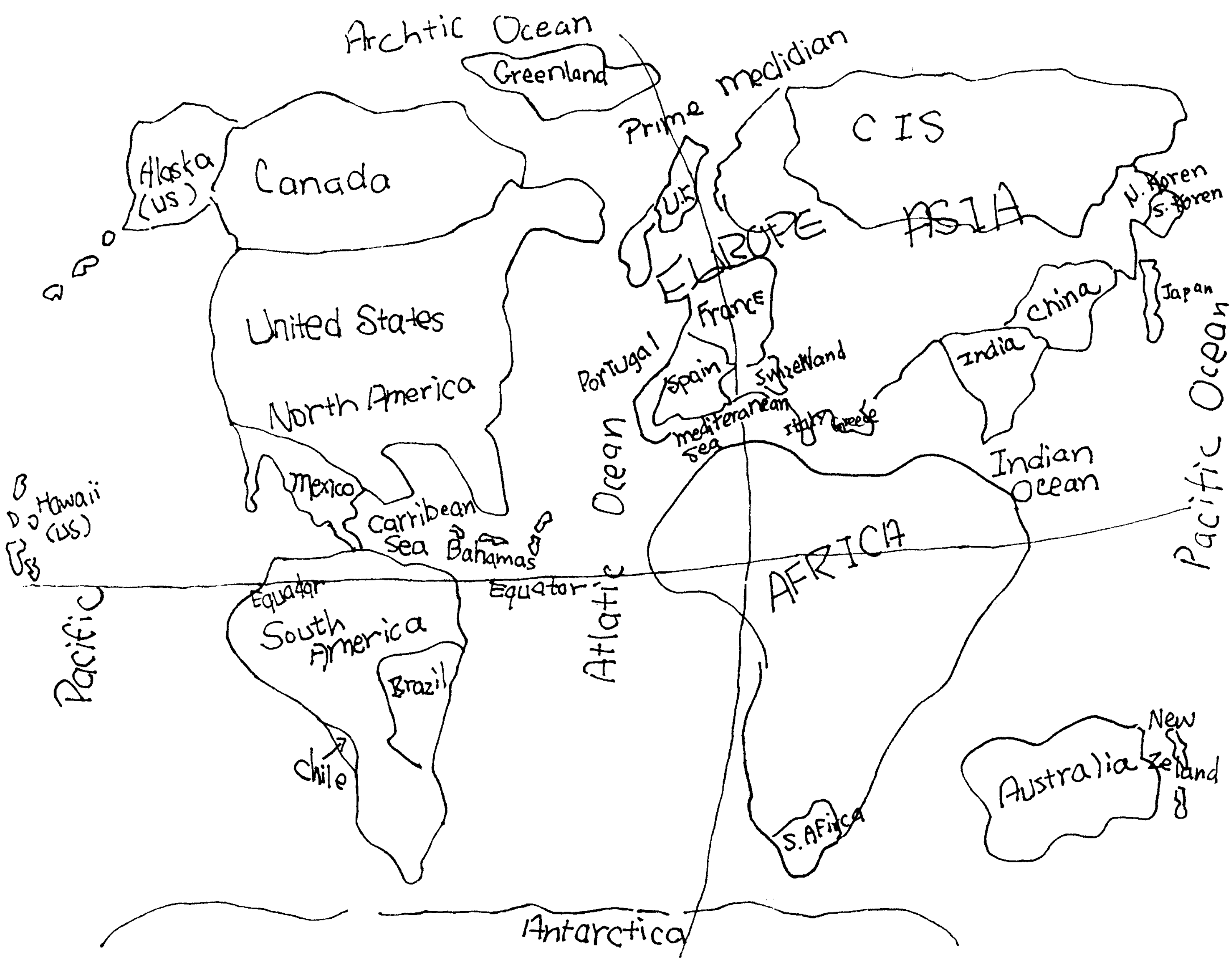
ITALY
GREECE
ASIA
CIS
USSR
Yellow sea
JAPAN
NORTH AMERICA
United States
MISSISSIPPI
MEXICO
GULF OF MEXICO
PRETO RICO
CUBA
PANAMA
VENERUALA
CARRABEAN SEA
30°N
TROPIC OF CANCER
HAWAII
MARSHALL 0° ISLAND
PACIFIC OCEAN
ATLANTIC OCEAN
STRAIGHT OF GIBERALTER
ALGERIA
NIGER
NIGERA
IVORY COAST
EGYPT
NILE
AFRICA
IRAN IRAQ
PACISTAN
NEPAL
CHINA
TIWAN
SOMALIA
INDIA
INDIAN OCEAN
equator
BRAZIL
Amazon
EQUATOR
SRI LANKA
NEW GUINEA
TROPIC OF CARRICURN
- 30° S
CHILE
URAGUY
CAPE OF GOOD HOPE
PRIME MERIDIAN
0°
S. AFRKA
MADAGASCAR
AUSTRHILIA
NEW ZEALAND
ANTARCTICA



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Greenland
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Bahamas
Hawaii (US)
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Equador
Equator
South America
Brazil
Chile
Atlatic Ocean
Portugal
U.K
EUROPE
France
Spain
Switzerland
mediteranean sea
Italy
Greece
AFRICA
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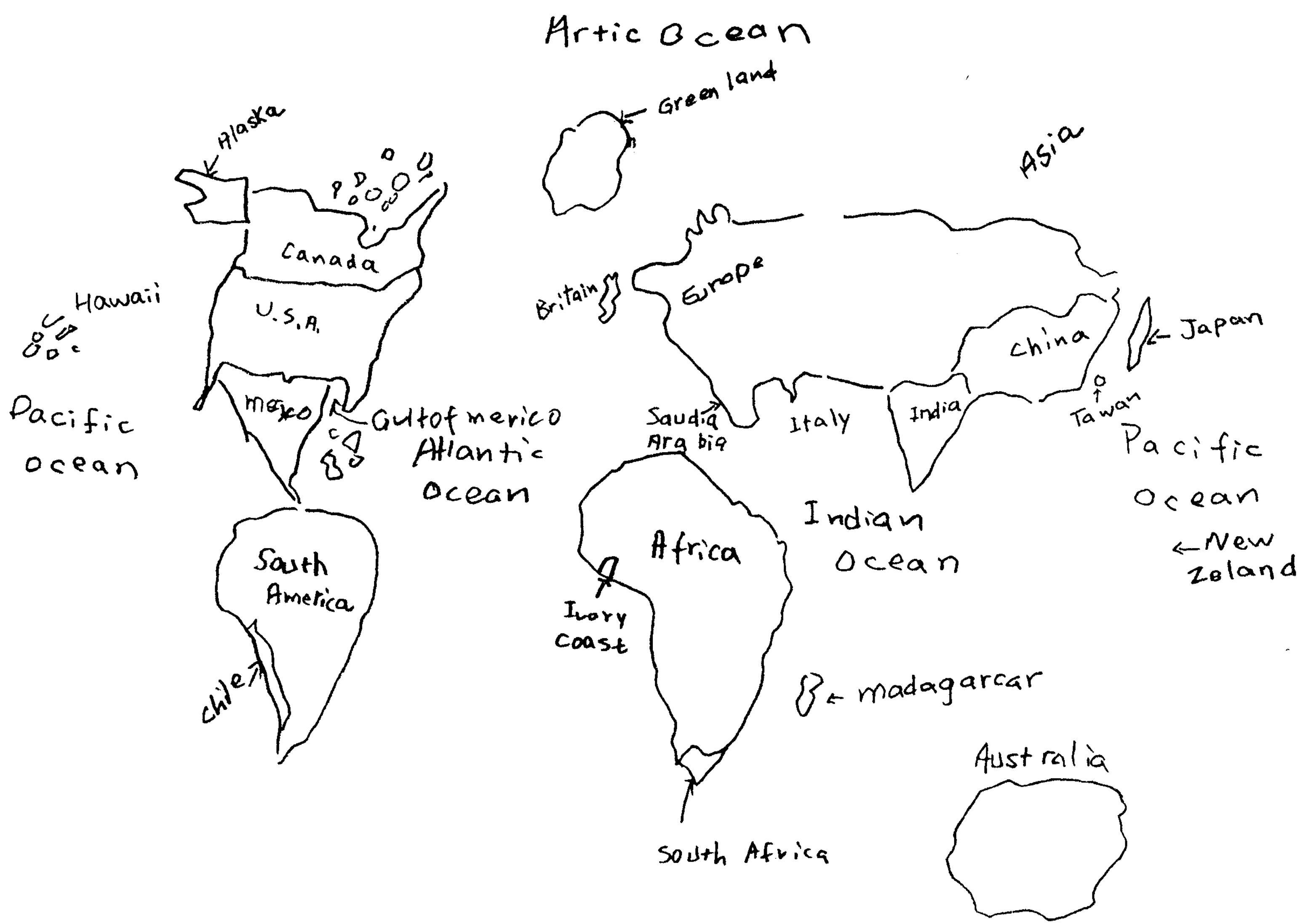
Japan
China
India
Indian Ocean
Pacific Ocean
Australia
New Zeland
Antarctica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Ocean
Saudia
Ara bia
Italy
India
Tawan
Pacific
Ocean
Indian
Ocean
South
America
Africa
New
Zeland
Ivory
coast
chile
madagarcar
Australia
South Africa

VITA

Dai Cui was born in Beijing, China on September 18, 1963, where she attended elementary school and high school. In 1981 she entered Beijing Normal University, and in 1985 received a Bachelor of Science degree in Geography. After graduation, she worked as a geography teacher in the Experimental High School attached to Beijing Normal University for six years.

In 1991 she was admitted to Appalachian State University and began work toward a Master of Arts degree in Geography. Her thesis, Cognitive Maps of the World: A Case Study in Grades Four Through Eight in Watauga County, North Carolina, dealt with analyzing how students' cognitive maps are developed. She was awarded this degree in August, 1993.